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ATOMIC ENERGY AND SOCIETY

BY JAMES S. ALLEN

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PREFACE

This is a preliminary attempt to assess the social significance of atomics. I use the term atomics to designate the new technology for the production and utilization of nuclear fuel.

Atomic energy is no longer exclusively a subject for prognosis. In the form in which it is now used it has become an awesome reality of contemporary life, with an unlimited potential for both destructive and positive uses. In fact, atomics has come to symbolize in a particularly striking form the general crisis of capitalism, which has become more acute after the war.

To cover the ground completely it would be necessary to write a history of the economics, social development, science, technology, diplomacy, military strategy, and the politics of our times. But I have undertaken nothing so ambitious. In this small book, attention is directed to the economic and political forces which affect the application and development of atomics.

It is difficult enough to assess the economic and social implications of a vital new discovery still in its initial application, with more discoveries and technical innovations in this field likely to come in rapid succession. But this difficulty is compounded many times over by the stiff military censorship, which imposes a mountain of restrictions upon the exchange of scientific and technical information. Whatever remains of freedom of discussion among scientists, and between them and the public, is now stifled almost entirely by "spy scares," congressional inquisitions, and "loyalty" oaths, ingredients of the same aggressive policy which results in the continuing militarization of atomics. In this atmosphere, vital public discussion has almost vanished in America.

As this book goes to press, the Soviet Union has confirmed that it has possessed atomic weapons since 1947, and has also renewed its proposals to outlaw these weapons under a United Nations control system. Thus, during practically the entire period in which American foreign policy was so largely based on the imagined monopoly of atomic weapons, the United States in fact did not have such a monopoly. Together with the hoax of the atomic monopoly, the cults of secrecy and of technological superiority are also shattered. On the basis of its own scientific and technical progress, the Soviet Union has mastered atomics, and now also indicates that it has gone far ahead of the United States in the development of this new power source for constructive uses. The main conclusions of this book are substantiated by this revelation.

For technical background I have had to lean heavily on the reports of official bodies. In view of the political tension which surrounds the subject, these reports have to be handled very selectively and very critically. They include the material released directly by the United States Atomic Energy Commission, the declassified reports made available by the Technical Information Division at Oak Ridge, and the official public records of the United Nations Atomic Energy Commission. Releases of the Atomic Energy Control Board of Canada and of the Ministry of Supply in London have also been used. Like others, I have drawn heavily upon Smyth's official report of the wartime project, and supplemented this by consulting standard scientific texts and other works on physics. Original material, reprints, and controversies appearing in the earlier issues of the *Bulletin of Atomic Scientists* of Chicago have proved useful, but this magazine is now losing its worth as an organ of discussion because of its increasing co-ordination into the official position. Occasionally, other periodical items were illuminating. Sources are cited in reference notes at the end of the volume when this seems necessary to substantiate a particular point, or when the material is quoted.

J. S. A.

I. POTENTIAL OF ATOMICS

Atomics is applied initially to produce a weapon of unprecedented destructive power. But in so far as the main line of development can be foreseen, the positive significance of atomics lies in the direction of multiplying by many times the useful power at hand for the production of goods, and for transportation. A new source of power is becoming available, potentially more abundant, more flexible, and cheaper than any now utilized.

To transform this constructive potential into reality is certainly one of the greatest problems of our generation. The problem impinges upon the most vital issues of our time, whether the issue be war or peace, poverty or abundance, the progress or retardation of science and technology, in sum, reaction or social advance.

Atomics, as it is now employed in the United States, has become the outstanding symbol of aggressive war. That science should reach this new height only to become the instrument of warmakers is not the fault of science but of the capitalist masters of science. The atomic bomb, perfected in the leading country of capitalism, is the supreme token of the decadence of that system.

Atomics is also a symbol of the immense productive forces at the disposal of humanity. At the moment the productive capacity of atomics remains potential, mainly because the new technique is devoted to military purposes. But it is also said that we do not need atomic energy, for we already have enough power, even more than we can use. Our capitalist society is embarrassed by "excess" capacity to produce, when large sections of our people suffer from the lack of life's necessities. Which indeed, is the greater sign of decadence: the use of our great productive forces for military purposes, or the *failure* to use them to improve the lot of the people?

Atomics becomes a significant component of the historic competition between socialism and capitalism. This competition assumes new proportions as the Soviet Union, so rapidly after the unbelievably destructive war, raises its production by half again over the prewar level, as the new people's republics of Eastern Europe begin socialist construction, and as China with its hundreds of millions of humanity has broken with imperialism. In this vast world sector, more and ever more productive capacity is the goal. Here productive forces used for war in defense of the people's gains, while necessary, are considered a waste of natural and human resources. It is the sector of peace. It is hungry for every new productive potential. Atomics, like science and technology in general, finds its natural home in socialism, which alone makes possible social planning, and, therefore, the use of productive forces for the benefit of the people.

These broad implications cannot be followed unless an initial effort is made to assess the proper role of atomic energy in the economic development of society. This is difficult at the early stage of a new technique as significant as atomics. Who could have foretold, for example, the full consequences of the steam engine or electricity when these first made their appearance? Yet the task of assessment is made even more difficult by the paucity of reliable information on the already known and tested processes of the new atomic technology.

This additional handicap arises from the militarization of the new technique at the moment of its birth. Extreme secrecy now clothes the industry. While the scientific and engineering principles of the atomic pile or reactor are generally known, data needed to judge the importance to the economy of specific industrial applications have been withheld. On top of this, the emphasis upon atomic weapons has had the effect of restricting and retarding extensive investigations into other more fruitful areas.

It is sometimes difficult to distinguish the real from the fantastic in the speculation about atomic weapons, around which atomics now revolves. Many unfounded speculations are also current about its possible peaceful uses. On the other hand, official reports are to be taken with great caution. The selection of information for these reports has become largely political rather than scientific, reflecting the emphasis required by guiding policy. The expression of independent scientific and engineering opinion on the social and political aspects of atomics is becoming so rare that the publication of a book by the eminent British scientist, P. M. S. Blackett, challenging the atomic control policies of the United States, is sufficient to cause something of a crisis in diplomatic and scientific circles.

Nevertheless, certain preliminary conclusions based on long-term scientific and engineering knowledge are inescapable.

THE NEW POWER SOURCE

The full theoretical potential of atomic energy was known for at least three decades before the first atom bomb was exploded. This potential is expressed in Einstein's famous formula of the equivalence of mass and energy, according to which the energy equivalent of matter is of a magnitude many millions of times greater than its weight. In practical terms this means that 25 pounds of matter, if completely transmuted into electricity without loss of heat, would more than equal the present annual output of power in the United States, which is over 250 billion kilowatt-hours. From the burning of 25 pounds of coal somewhat over 90 kilowatt-hours of heat is produced. The comparison between 90 and 250,000,000,000 is enough, for all practical purposes, to justify the claim that the potential of atomic energy is indeed limitless.

This theoretical potential has been brought closer to reality by the discovery of uranium fission, and subsequently by the mastering of the technique of maintaining a chain reaction. The same processes and materials used until now to prepare weapons can also be used for peaceful purposes, as official reports never tire of asserting. Some uses of the by-products of the atomic pile are by now quite familiar. Isotopes and other radioactive materials provide invaluable research tools which will no doubt lead to new scientific discoveries of importance. These materials, as well as the radiation of a pile, are also very useful in therapy, and in various complex industrial processes as sensitive measuring and control agents. Further research in isotopes promises to improve existing materials and to create new materials for industry and for consumption.

While these by-product activities are significant in many ways, they remain peripheral to the central function of atomic energy as a source of useful power. It is already possible to indicate in concrete terms the immediate potential of atomic power.

In the literature on the subject it is said that one pound of plutonium or of uranium-235, the fissionable materials now produced in the American project, should yield from two and one-half to three million kilowatt-hours of electricity, at the efficiency of existing apparatus for transforming heat into electricity. At the latter rate, about fifty tons of fissionable material, which can be transported in a single freight car, would suffice to supply the present annual output of electricity in the United States. One-third of this is now supplied by hydroelectric power, but it takes 115 million tons of coal (including the coal equivalent of oil and gas used in power production) to supply the balance.

The amount of fissionable material contained in the first atomic pile, which began operation at the University of Chicago in 1942, would be enough to keep the entire power industry of the United States in operation for almost two years. It has been pointed out that the present uranium piles contain a capital investment of uranium equivalent to the consumption of decades.[1]

Before this extraordinary potential of atomic power can be realized, some technical problems connected with transferring the heat of the atomic pile to a boiler have to be solved, but these are as nothing compared to the basic processes already mastered. No matter how widely experts may differ as to the time it will take to make available efficient and cheap atomic power, there is no doubt among them that this can be done on a substantial scale—according to the more optimistic estimates within a decade, and the less optimistic within three or four decades. In any case, the main obstacles seem to be economic and political, rather than technical.

The point is we can have atomic power, the speed with which it is attained and used depending primarily upon the social impulses at work. Furthermore, the known characteristics of atomic energy indicate that in time it will be derived not only from uranium and thorium but also from other materials. In fact, the source material seems inexhaustible. This, together with the unique compactness of the nuclear fuel, makes it reasonable to expect the eventual use of atomics on a universal scale. For the present, its use is immediately feasible in power stations, where it can take the place of coal or other conventional fuels to produce steam, which in turn will drive a turbine for the production of electricity. The current thus produced could be distributed over the existing utility systems. This is the initial stage now considered entirely practical.

Even at this stage atomic power might soon possess many advantages over coal, oil, natural gas, and perhaps water power as well. In an industry as young as atomics it can be expected that the efficiency of present methods of producing fissionable material can be improved quickly and radically, so that atomic fuel in power stations will represent a worthwhile saving over the conventional fuels, even if in the face of this competition the efficiency of the latter is also greatly improved.

The significance of the cost factor goes much beyond the question of economy or saving in the narrow sense. A number of writers on the subject have held that for industry as a whole the power cost constitutes so small a part of the cost of production that the savings resulting from the use of atomic fuel could hardly become a decisive factor favoring atomic power over other forms of power.[2] They overlook the entire history of the power industry, which is a progression to ever cheaper power and also to more flexible forms of power, in response to the needs of modern industry.

This tendency is now accentuated by a number of factors, despite the basic retarding influences of overcapacity in relation to markets and of monopoly. One of these factors is the increased importance of newer industrial processes using large quantities of electricity, in which the cost of power becomes a substantial portion of the total cost of production, as in the treatment of metals, and the synthetic and chemical industries. Another consideration, which plays a role in certain economic branches, is the new flexibility provided by atomic power with respect to the location of processing industries in relation to raw materials, as in the case of aluminum and bauxite, where the cost of electricity also plays an important role. It has also been pointed out that atomic power would prove very useful from the start, even if still uneconomical in relation to other fuels, in regions poor in fuels and water power, but which may have valuable raw materials.

In economically backward areas, now on the verge of industrialization because of the rise of the colonial freedom movements, atomics also has great potentials. In an absolute sense, cheap and flexible power is indispensable throughout the colonial and semicolonial world, as in Latin America, Asia, and Africa, if the peoples of these regions are to achieve better livelihood and genuine freedom. Imperialism is the great retarding factor. Therefore, the break with imperialism that has taken place in China and is proceeding in Southeast Asia brings closer the possibility of rapid and balanced economic development in these countries. In other regions, where the democratic people's movement against imperialism has not yet reached this stage, pressures nevertheless do operate in the direction of industrial development, although when this does take place it is painfully slow and assumes distorted and unbalanced shape, because of imperialist domination. In general, in the situation following World War II, in which the shift of world forces towards socialism is greatly accentuated and imperialism is basically weakened, the struggle for colonial independence reaches new heights, thereby enhancing the possibilities of economic development in regions inhabited by the greater part of the world's population.

In such countries the entire complex of industry is still to be established almost from scratch. Atomic techniques provide the possibility for the most economical and flexible location of industry in relation to power and other factors of production. Hydro and other sources of power need not necessarily be discarded; in fact, they might well prove indispensable in relation, say, to water and navigation needs, or the development of the steel industry. But atomics introduces a greater range of freedom, and therefore also of efficient use of resources and human skills, in the industrialization and development of hitherto economically backward countries, once the political prerequisites for such a course have been established.

Atomics promises to provide cheaper power, and, even more important at this stage, in a form more adaptable to a variety of conditions than hydro, coal, or oil. It is therefore in the direct line of progress of the power industry. At the early stages of atomics, the fact that the cost of nuclear power may be little less than a steam-power plant is not as decisive as the fact that the cost of atomic fuel will not serve as a barrier to its use where flexibility is the most important factor. In time, as the new technique develops, atomic fuel may tend to replace the bulky conventional fuels everywhere.

AN INDUSTRIAL REVOLUTION?

It has often been said that we are now on the verge of a new "industrial revolution" as a result of the initial mastery of atomic fission. If the term is used to signify an important technological advance, comparable to the invention of the steam engine, the mastery of electricity, and the development of the internal-combustion motor, the characterization is not overdrawn. The new atomic technology, although it now stands only at its initial stage, promises to enhance the productive forces of society at least as significantly as those mentioned. But the term needs further critical examination if it is used to designate qualitative social changes of the kind which received their impulse from the industrial revolution at the dawn of the capitalist era.

Let us recall that the industrial revolution associated with the birth of capitalism did not arise primarily from the invention of prime movers.[3] These existed in previous stages of social development, without industrial application, as was the case with windmills, water power, or even Watt's first steam engine. In the preliminary stage the new industrial technique took over some of these sources of power, even in their primitive form, a water wheel or even a windmill sometimes being used to drive a group of machines. The characteristic innovation of the industrial revolution was the machine, which did the work formerly done by handicrafts, often utilizing tools as part of its mechanism that were formerly used in hand manufacture.

The decisive element in the organization of production corresponding to the development of machines was the factory. This development stimulated basic changes in society as a whole, the emergence of new classes corresponding to the new mode of production, and of an entire superstructure of government and social institutions which came to be characteristic of capitalism. It is this development in its totality that gives meaning to the term "industrial revolution," even if is use is restricted to the technological phase of the social transformation.

However, power played a highly significant role in increasing the productive forces. For the development of machinery required a corresponding development of prime movers adaptable to factory production. The new system needed power completely controlled by man and usable in the towns and cities—requirements that could not be met by wind and water power. The steam engine, which transforms coal and water into power and is capable of turning a number of machines simultaneously, fulfilled the needs of machine production. As industry also took over from handicrafts the making of machines, and as the growth of the world market heightened the tempo of production, more power was required. This was first met by building enormous steam engines, and later by increasing their efficiency, a process that has continued to the present.

As production expanded further in response to the growth of the world market, and as industrial processes became more complex, ever greater quantities of power were required, and also in forms that could be more universally and more efficiently used than steam. Electricity and the internal-combustion engine met these needs. Both in turn facilitated the very rapid expansion of the productive forces.

Electricity cheapened power, increased the efficiency and speed of production, accelerated mechanization in all branches by making power more easily available, and led to the introduction of new industrial processes using large amounts of electricity. The internal-combustion engine increased the efficiency of supply and the rate of turnover of capital by greatly expanding and accelerating all forms of transportation, favored the mechanization of agriculture, stimulated the petroleum industry, and also gave birth to the giant automobile and airplane industries. These techniques, alongside new chemical and electrolytic industrial processes, served as the foundation for the great advance of productive forces during the past half century, and especially since the first World War, although the new technology was only very unevenly and inadequately developed, and was devoted increasingly to destructive purposes.

Each innovation was in its time hailed as "revolutionary," and the higher stage of technology corresponding to these inventions has often been called the "new industrial age," or similarly characterized, with implications that they introduced qualitative changes in the basic structure of capitalist society of benefit to the people as a whole.

Actually these innovations did not lead to a revolution in the *mode* of production, although they did necessitate significant changes in the *organization* of production, which in turn had important social implications. Machine-factory organization remained the basis of the industrial structure, now swollen to immense proportions. The new power sources and processes made possible new and more efficient machines, geared to continuous-flow methods of production, that turned out more products in less time and with less expenditure of labor power, although the labor power employed was more intensively exploited as a result of rationalization and speed-up.

The innovations of the twentieth century also greatly facilitated the concentration of production into immense units, and on top of that the pyramiding of control by monopoly groups which is characteristic of the imperialist era. In this and other ways the new techniques affected the capitalist social structure. While they inevitably accelerated the growth of productive forces despite the retarding effects of monopoly, the great technical advances did not alter the basic capitalist mode of production, only increasing the exploitation of the workers and the class differentiation of capitalist society. Above all, the great advance of techniques widened immeasurably the gap between the tremendous potentials of our productive forces and their actual utilization in the service of the people. Private ownership and monopoly control of the means of production stand in the way of their social utilization, with the result that each new advance of technique has the effect of deepening this contradiction, and thereby intensifying the inner tensions and conflicts of capitalist society.

Atomics makes its appearance alongside other significant techniques—such as radar, jet propulsion, television, new chemical and electrolytic processes, and also the extensive control and servo-mechanism progress of the last few years, with its implications for the automatization of large-scale industry. This extraordinary development greatly increases the productive potential of our economy, and thereby also accentuates the already gaping contrast between the immense possibilities of modern technology and the extremely limited performance of the economy.

Thus, the birth of the atomic industry does not in itself presage a revolution in the mode of production, although it will vastly accentuate all capitalist contradictions. Considering atomic energy from the viewpoint of its positive function as now discernible, its technical significance for the immediate future is to extend greatly the potential power resources at the service of production. If applied on a substantial scale, it can greatly accelerate the growth of productive forces, (*a*) by cheapening power still further and perhaps later making it more universally available than any previous source of power; (*b*) by conserving minerals like coal and oil for other uses with a corresponding rise in the productivity of labor in the field of fuel supply and transport; (*c*) by the introduction of new industrial processes, automatic controls, and materials; and (*d*) by facilitating industrialization in economically backward countries, once the political prerequisites have been won.

All this would seem to be possible even at the present stage of atomic technology, when atomic energy would be used principally as a fuel to replace the conventional fuels in the production of electricity. It is within this domain also that various innovations in the sphere of transport may soon be possible, at least in the transport units sufficiently large to accommodate an atomic reactor and the heavy shielding required against radioactivity. If official reports are to be taken as a guide the only application of atomic propulsion now possible is on heavy naval craft, using the same type of reactor that would be utilized in a central power station. Also according to official sources, atomic aircraft, long-range missiles, and all forms of land transport must wait many years for the solution of difficult problems associated with the use of atomic power in smaller units.

However, it would appear that the transformation of atomic energy directly into useful power would lead to the most radical changes in technology. In other words, if atomic energy can be used directly in "capsule" or whatever form to drive machines, without first having to produce steam or gases for turning turbines and producing electricity, we may indeed stand on the threshold of a basically new machine technology. The atomic equivalent of the internal-combustion engine or, as has been suggested, an atomic storage battery,[4] would certainly introduce significant changes.

This line of development, while there is as yet little evidence of its immediate feasibility, may indeed lead to qualitative changes in the organization of production, the main outlines of which cannot be seen at present. Like other basic technological advances, these would greatly stimulate the extension of productive forces, the beneficial employment of which depends primarily upon the form of society. In any case, it serves no useful purpose to speculate on the economic and social implications of discoveries still to come, when the real question that faces us is how to use for the benefit of the people the tremendous productive forces already at hand and only partially employed.

To sum up: The growth of productive forces does not *in itself* lead to a basic social transformation, although it does greatly deepen the contradictions of capitalism and thereby contributes to creating the forces making for social change. It is rather the failure of capitalism to employ these immense productive forces in the service of society, together with their growing restriction by monopoly and even destruction in war and economic crises, that brings forward the necessity for the socialist transformation of society. Nowhere is this presented more sharply and insistently than in the case of atomic energy.

Even in its initial stage, as we have seen, the new industry promises to multiply the useful power at our disposal and to perfect technology in many branches of industry, thus increasing the goods and leisure potentially available to society. But it is precisely this aspect of atomics that has been sacrificed to obtain an arsenal of atomic weapons, and thereby also assuage the fear of excess capacity which dominates our society.

In only two years the American wartime atomic project mastered the first and most difficult processes to harness the energy of the atom for destructive purposes. Yet over three years after the atomic devastation of Hiroshima, and although the basic knowledge had been acquired to put this new abundant source of energy to work for constructive purposes, the bomb remains the chief end-product of the gigantic industry in the United States. Certainly, it is not too much to expect that even a part of the effort that produced the first bomb could within a similar time produce a central power station in a country that prides itself on its engineering know-how. But we are told by the Atomic Energy Commission, three years after the bomb was first used, that it will take at least another decade to produce on an experimental basis a fairly practical apparatus for the large-scale generation of electric power using uranium as a fuel.[5]

Present experiments with the production of atomic power for peaceful purposes are puny and snail-like compared with the effort that goes into the production of weapons and their perfection, using up for this purpose the available raw material and the best scientific and technical skills. It is difficult to find a better example than the atomic industry as it now stands in the United States of the frustration of science or of the suffocation of the people's aspiration for better living aroused by new discoveries.

Here is revealed in extremely sharp form the deep crisis of our society, as expressed in the multifarious ways that atomics impinges upon the most vital issues of our time.

II. MILITARIZED ATOMICS

Circumstances surrounding the birth of the new industry have left an indelible mark upon atomics. Total emphasis upon the bomb set the framework within which nuclear science was first to be applied on a large scale.

How deeply this affects atomics as a whole is still hardly realized in full. The harshly restrictive features that are now felt within the new industry originate largely in the birth of the industry as a war project, and are prolonged by the continuing emphasis upon its military uses. The martial status of the industry not only determines its present technological structure, but also imposes severe limitations upon the science and application of atomics in general.

THE MISUSE OF WORLD SCIENCE

The Manhattan District, as the wartime atomic project was known, had only one aim: to produce a bomb from the scientific knowledge already at hand. Science in many countries had supplied the key to controlled atomic explosions. The American scientific contribution was very small. The entire line of development leading to nuclear fission occurred mostly abroad, and in more recent years was carried forward in the United States largely by European scientists seeking refuge from fascism. On the eve of the war, the fission of the uranium atom with the release of enormous quantities of energy was demonstrated simultaneously on a laboratory scale in a number of countries, including the United States.

It had also been surmised that in this process the nuclei emitted neutrons which might extend the process of fission in other nearby uranium atoms, thus creating a chain reaction. The fissionable characteristics of the new element plutonium, derived from the fission of uranium and now produced on a large scale at Hanford, Washington, had also been indicated. New techniques developed in laboratory experiments provided an initial guide for the technology of large-scale operations.

Although many complex problems of materials, engineering, and technique remained to be solved, the essential preliminary scientific and experimental work had in the main been completed by scientists throughout the world. Many of them were brought into the American atomic project, with the outstanding exception of the Soviet scientists, despite their basic contributions in this field. When the Manhattan District was organized, says Prof. Henry D. Smyth in his official survey, *Atomic Energy for Military Purposes,* "all the prerequisites to a serious attack on the problem of producing atomic bombs and controlling atomic power were at hand."[1]

What happened afterwards may be described as the technological consolidation of one aspect of nuclear science at the level the science had reached in 1940. Fully ninety percent of the two billion dollars expended on the atomic project during the war was for engineering and construction. No more than ten percent was devoted to research, and this largely to improve existing methods rather than to extend the scope of the science and its application.[2]

New materials, processes, engineering skills, and instruments developed in this effort—many of them applicable to a wide range of industry—were chained to the single military objective. After the first bomb had been made and proved, the industry thus created was devoted to increasing bomb output and to improving the efficiency of the weapon. The inevitable search began for the superbomb, which would be many times more destructive than the preceding one. Further techniques and skills were applied to the apparatus of transport necessary to send a bomb with ever deadlier efficiency to its target.

More than three years after the surrender of Japan, according to one estimate, at least eighty percent of the new industry's capital and effort was devoted to maintaining and improving military production.[3] Even within military limits, production of explosives for the atomic stockpile took precedence over work on the atomic propulsion of warships, planes, and missiles—a field in which new discoveries may perhaps be applied also in peacetime transport and industry.

Unavoidably many of the technical innovations and by-products of this military industry are applicable to other branches of the economy, to therapy, and in the laboratory. A significant fund of knowledge has been accumulated on the chemistry and metallurgy of the uranium elements and other materials used in production, and on the operation of atomic piles or reactors. This is of constructive value and may in time be applied to civilian industry and space heating. But how are these incidental benefits, as important as they may become, to be measured against the incalculable losses resulting from the concentration of science and technique upon the bomb? Aside from the obvious dangers arising from the monopoly (as temporary as it has been) of the new weapon by the prime world imperialist power, these losses are felt most tangibly in science and in many spheres of industry.

Nuclear science has been retarded and its perspectives have been distorted by the militarization of the new industry. As a result of total devotion to the bomb during the present initial phase of the industry, only one method of releasing atomic energy, and this method only within the narrow range of the uranium elements, has been developed. Even within this area, the industry was unnecessarily narrowed down to methods and processes already proven or promising the most immediate results in the production or improvement of atomic weapons.

The entire structure of the industry is tied to vital decisions on materials and technology made during the war. Such decisions were not always based on the best scientific or engineering judgment but were often determined by considerations of military expediency. Other decisions involving more universal objectives than making a bomb may have resulted in far more useful and economical techniques than those now employed. To cite only one instance: Rather than devote the necessary effort to devise means of utilizing the heat generated by the plutonium reactors at Hanford to produce electric power, this heat is given off as waste in the waters of the Columbia River.

It has been stated by specialists prominently engaged in the wartime project that some of the specific techniques developed at that time and now being expanded are among the principal obstacles to industrial application, because they are unnecessarily wasteful and costly.[4] Processes perhaps already obsolete are still continued in operation to obtain the greatest possible output of fissionable materials for weapons.

The gas diffussion plant at Oak Ridge, Tennessee, which separates the fissionable isotopes of uranium from the natural metal, has been cited as among the most wasteful and most expensive of all processes developed during the war. Apparently, plutonium production is far superior as a means of producing fissionable material, and it also is the route by which the natural uranium resources can be most fully utilized. Because of the extreme compartmentation that prevails as part of the code of secrecy, it is difficult to obtain from available literature what appears to be a sound estimate of the gas diffussion method in relation to the larger picture of atomics. It may find a useful place in certain aspects of constructive atomics. But in the present industry its role seems to be determined primarily by the predominant objective of piling up fissionable material for weapons, no matter how wasteful or overcapitalized the process may be.

As matters now stand, the established technology, which already represents a state investment of three billion dollars, may be rendered obsolete rather quickly by new discoveries in the field of atomics. The highly capitalized technique would in that case become a serious obstacle to the development of atomics.

RESTRICTION OF NUCLEAR SCIENCE

The basic limitations of technique, arising from the belligerent status of the industry, are complemented by equally disastrous restrictions upon serious and systematic researches into other more important areas of atomics. Research in general has become increasingly centralized under government auspices, and especially under the military. Most research funds are now controlled through the government agencies, whether they are used to finance work in government or university and corporation laboratories. This is especially the case with basic nuclear research and development, which requires very complex and expensive machinery.

According to the Atomic Energy Commission, fully two-thirds of all basic nuclear research in the country is financed in whole or in part by the federal government,[5] which means that it is subordinated to the military policy. The result is that atomic research is discouraged, if not entirely choked off, in those phases that promise little of practical value in a military sense. Where development work for constructive purposes is undertaken, as experiments with reactors for electric power, it is subordinated completely to the central military function of the undertaking.

Among many scientists the opinion prevails that the wartime project and the continuing emphasis upon weapons blocked rather than advanced nuclear science. Among others, Dr. von Neumann, of the Institute of Advanced Study at Princeton, made this point at hearings on the Atomic Energy Bill of 1946. He also expressed the opinion that it is entirely unpredictable what source of energy will appear within the next five or ten years. It was his belief that within a few years the light elements may produce more important results than uranium.[6] During discussion in the Atomic Energy Commission of the United Nations, Professor D. V. Skobeltsyn, the eminent Russian physicist who has made notable discoveries about the particles of the cosmic rays and who served as a member of the Soviet delegation, also stressed the greater potentials of the lighter elements, along with the meson particle and the cosmic rays.[7]

In the United States, however, official opinion seems wedded to the idea that for some time to come there can be no significant change in the application of atomics, with respect both to the raw material and the essential processes of production. The American industry is being greatly expanded on that basis, and it is also the central thought that determines present policy.

The Acheson-Lilienthal committee, whose report served as a basis for the United States plan for international control, emphasized that uranium "is the key to all forseeable applications of atomic energy."[8]

The first report of the Atomic Energy Commission of the United Nations to the Security Council acknowledged the possibility that methods might be found to separate the isotopes of uranium in a manner less elaborate and cheaper than presently used in the United States. It also conceded that some day raw materials other than uranium or thorium might be found suitable for the production of nuclear fuel. However, the Commission majority considered the latter possibility "highly speculative," and following the American lead proceeded on the basis of the established uranium-atomic industry as it functions in the United States.[9]

However, this official position corresponds only to the present status of the atomic industry in the United States. The industry is producing fissionable material in mass quantities, as measured by present norms. It may also develop substantially from the present base by extending the fission process into the next stage of "breeding," by which a much larger portion of natural uranium than is now used in the production of plutonium may be "burned" to produce fissionable material. Breeding would also allow the use of thorium, the known deposits of which are more extensive than the rich uranium workings now known. Thus, the present industry may develop further, even within a relatively restricted area, into a uranium-thorium industry, capable of producing much greater quantities of nuclear fuel than now available.

Notwithstanding this significant beginning, and the official judgments that have been cited, there seems substantial scientific ground for expecting new discoveries in the near future that may introduce more efficient and cheaper atomic processes than now prevail in the American industry. Even within the range of the heavier elements, and the fission processes already discovered, means may be found of tapping the energy of elements other than uranium and thorium, and perhaps more abundant and more easily processed. New and simpler techniques than those now employed in the very highly capitalized American industry may be found. In other words, even on the basis of the present atomic industry, significant innovations are possible. It would be nothing new in the history of science and technology if such innovations should follow in rapid succession, now that the field is being intensively explored on a practical basis in many countries.

In the United States the impression seems prevalent in official as well as some scientific circles that knowledge of other methods, such as the synthesis of light elements, the cosmic ray, and the meson, is still too elementary and fragmentary to expect new practical developments from those quarters in the near future.

It is pointed out that the first use of the light elements, if the stars are any guide, would be in the direction of explosions and not controlled power. The principal obstacle that is mentioned in this connection is the unsolved problem of how to handle the high temperatures of the thermo-nuclear reaction. It may well prove to be the case that the cosmic particle and the light elements may not provide at the present known stage of the science a new departure in atomics in the near future, although, as already indicated, there is a considerable difference of opinion on this among scientists. Extensive experimentation on the cosmic particle is proceeding, and the Soviet scientists are especially noted for their accomplishments in this field.[10] The history of science being what it is, one may well question the fundamental premise of American atomic policy, especially since that view fits neatly into the deceptive pattern of an atomic monopoly by the United States, which plays so central a role in American diplomacy.

As the science stood in 1940, there were few at that time who could have foreseen the practical development that took place within a few years. The laws of the development of science are not so different from the laws of social evolution as to exclude revolution in the sense in which that term may be applied to science. Every great advance in science has been due to such a revolution—the discovery of a new relation among phenomena that leads to a qualitative leap in the development of scientific theory. The discovery of radioactivity and Einstein's mass-energy equation were part of a chain of discoveries that constitute such a revolution in physics, reaching into every other science. A revolution of this depth is never static, since it opens a new phase of development that must proceed towards maturity. This seems to be the dynamics of science as of society, and there is little reason to exclude atomics from its operation.

Some who view the bomb as the golden gift of science to America would no doubt like to excommunicate the present-day Galileos who insist that nuclear science, far from having reached the apex, stands only at the threshold of its most important discoveries. But it remains incontrovertible that the earth moves, or in contemporary terms, that the realm of atomic energy is limitless.

IDEALIZATION OF TECHNOLOGY

If the American atomic policymakers seek refuge in the ancient superstition that history will stop long enough for them to achieve an absolute monopoly, they have also created a cult of technology.

It is generally recognized, even in the United States, that the lead enjoyed in the field of atomics was due not to superior scientific knowledge, but to the ability of the country, untouched by war, to marshal its plentiful resources to engineer the bomb. This lead is now threatened by independent developments abroad. Other countries are already duplicating certain phases of the American process, despite its high cost and involved technology, and are also developing new procedures that are more economical and can be applied more universally to industry.

In America the tendency is to overemphasize superiority of technique and the greater wealth of the economy in this international competition. These factors are important, but they are not decisive in an age when differences between countries on questions of technique are qualitatively not very great.

During Congressional hearings on atomic energy after the war, the engineering manager of Stone & Webster, one of the big construction firms engaged in the Manhattan District, made the point that the magnitude of the engineering job was so great and involved such huge expenditures that it would take many years for other countries to duplicate the American industry. He held that even the British, who he conceded might possess the industrial organization for the job, would require a number of years to build atomic installations once they discovered how to do it. His inference, as well as that of other industrial experts, was that the Soviet Union, which he assumes is below Britain in level of technology and industrial organization, could easily be dismissed as a serious competitor.[11]

Yet the supposed inferiority of technique seemed to present no obstacles to other countries in building atomic piles and other atomic installations. The Canadian enterprise at Chalk River can be considered more a part of the American atomic industry than an independent undertaking. Nonetheless, it is also a product of Canadian and British skills and science. As a member of the tri-partite atomic bloc, Britain was perhaps favored more than other countries by the United States in receiving certain restricted access to raw materials and information. In any case, within three years after the end of the war Britain had managed to build two atomic piles and other complex atomic installations. The second pile at Harwell took less time to build than a similar reactor that was still under construction in 1949 at the Brookhaven center of the United States Atomic Energy Commission. Britain already produces plutonium and all the isotopes it needs, and has a number of high-power piles in the process of active design.

Under the direction of Frédéric Joliot-Curie, the French demonstrated great engineering flexibility by using uranium oxide, instead of the refined metal, and heavy water in the reactor, making the best and least costly use of the materials and processes available to them. Even small countries like Sweden and Norway are building atomic piles, the latter country using uranium derived from oil shales. India, which contains the largest known deposits of thorium, also has plans for atomic development, as have many other countries.

Most of these countries are denied access to the restricted data of the American atomic project. Shipments of pitchblende and graphite, which are monopolized by preclusive buying, and other essential materials have been withheld by the United States. The Anglo-American Board has attempted to maintain a strict censorship over European scientists, to prevent the exchange of information among them that would facilitate atomics in their countries.[12] Even Britain, presumably an equal partner with the United States in their global bloc, has been denied the most confidential information and its scientists have complained against the strict American secrecy about the plutonium process, which is the present road to atomic power.

If it is possible for many countries, in accordance with their means and resources and despite the American monopoly, to establish the beginnings of an atomic industry, the Soviet Union should have little trouble, with its vast resources, new technology, and trained scientists and technicians, not only to master what has already been accomplished but to pioneer significant new channels in atomics.

Considering at this point only the norm of technique, there seems little ground for the prevailing idea that the United States is so far ahead in the field, and other countries so relatively "backward," that by merely keeping its "atomic secrets" while stockpiling bombs at the expense of constructive atomics, the United States can be assured of a continuing monopoly.

THE CULT OF SECRECY

This idealization of technique also contributes to the cult of absolute secrecy with which it is thought the atomic monopoly can be maintained. This cult of secrecy, supplemented by "spy" scares and the system of "loyalty" oaths, actually plays havoc with nuclear science, and in the long run will result in an inferior technology. Many scientists have already attested to the obstruction of research and of new applications of atomics as a result of extreme secrecy, and of the bans on interchange of scientific information among scientists participating in various phases of the project.

During the war, even Britain and Canada, although favored by participation in the Manhattan District, were denied access to many phases of the undertaking, while the Soviet Union was not even informed of its existence. Such measures can be understood only if the intention existed from the beginning to prolong the American monopoly after the war, and to maintain it as a military monopoly. The extent to which atomic secrecy retarded the new technology is indicated by a statement of Alvin M. Weinberg, a theoretical physicist of the Manhattan District, that at the end of the war no more than fifteen men in the country had sufficient technical knowledge to erect a nuclear power plant.[18]

Nuclear science suffered even more fundamentally. Dr. Frank B. Jewett, president of the National Academy of Science, and for forty years before assuming that post the director of research at the Bell Laboratories, expressed an opinion widely held among his colleagues, when he told a Senate committee:

"Our contribution to the fundamental stockpile (of scientific information) was small—quite important, but nevertheless small . . . and had we been dependent upon our own contributions to fundamental science, we never could have had an atomic bomb here."

Accordingly, he held that the ban on international exchange of scientific information operated to the greater disadvantage of the United States than of other countries, since American scientists had most to gain from such an interchange.[14]

Given the guiding military policy, it would seem that science had already served its purpose in showing how to produce the bomb, and the stockpile of scientific knowledge could therefore be sacrificed for stockpile of atomic explosives.

Secrecy of science is largely a myth. The principles involved in atomic fission, and the processes by which it is induced, are as well known abroad as in this country. Secrecy may withhold from other countries information about the special equipment and some technical operations of the American project—the kind of commercial secrets that are common in monopolized or cartelized business. But it is just as likely that other countries are withholding information on developments at least as significant as these.

By and large, the restrictions now in force are of little value from the viewpoint of preventing the development of atomics abroad. On the other hand, they are excessively harmful in hindering the application of atomics to industry in this country, preventing independent efforts in that direction. The official restraints are very similar to the restrictions imposed by monopolies and cartels to prevent competition from newcomers and from unco-ordinated enterprises.

According to the Atomic Energy Act, restrictions on information apply not only to the bomb but include data on "production of fissionable material, or the use of fissionable material in the production of power." This seems to cover the entire range of nuclear science and technique at the present time. As Newman and Miller declare in their book, *Control of Atomic Energy,* this is the first time in centuries, aside from the medieval reaction of the Nazi-fascist regimes, that a state has attempted to ban discussion of scientific data relating to the laws of the universe. They consider this policy a danger to democratic rights and a "warning precursor of a host of restrictive enactments to come."[15]

Atomic secrecy is officially defended on the ground that the industry cannot be divided into two, into a section devoted to weapons and another devoted to peaceful industrial purposes. The reason for this, it is held, is that every major process used in manufacturing the ingredient of the bomb is equally applicable to producing atomic energy and its by-products for industrial or therapeutic uses.

The basic fallacy involved in this reasoning is the same as applies to the entire concept of national security as a product of superior weapons, no matter how inferior foreign policy may be. But another great fallacy is involved.

It is, of course, true that the same materials and processes that go to make the bomb, except for its final assembly, would be employed in a power reactor. Moreover, a power reactor while in operation would in turn produce new fissionable material that could be used in a weapon. But this is not a completely new situation.

Most industrial techniques and products, as well as our industrial structure as a whole, can be utilized for war or for peace. If we were to follow this logic it would be necessary to place the steel, mining, chemical, and many other industries under permanent military supervision. Steel can be used in a residential building or in a warship; and the engine capable of supersonic speeds can be employed to carry an atomic bomb or in peacetime transportation. These contradictory potentials are characteristic of every branch of the economy.

If at this point the vast destructive force of atomic energy is cited to justify the policy of restriction, then it can be pointed out that chemical and bacteriological poisons just as potentially destructive if used on a mass scale are constantly employed in industry and medical research, yet no one suggests that the corresponding chemical and fermentation industrial operations be placed under a ban.

It is indeed difficult to see, as the Soviet Union has suggested, why the use of fissionable materials for destructive purposes cannot be outlawed by the usual internal measures of each country and by international agreement, as in the case of poison gases, while allowing the fullest utilization of atomic energy for constructive purposes.

A MILITARY MONOPOLY

The question therefore arises whether considerations, other than safeguarding the bomb secret as long as possible, do not play a powerful role in maintaining the strict guard over atomics. And one must come to the conclusion that these considerations are to be found in the desire to delay the application of atomic energy to industry everywhere, to prevent the new technology from bursting out of the military prison to which it has been sentenced in the United States, in a word, to maintain the new industry not only as an American monopoly but as an American *military* monopoly.

In addition to the obvious military reasons for this policy, it also has other advantages for the monopoly groups. As long as atomics is devoted to weapon production, the specter of additional excess capacity raised by atomic power is for the moment laid low, and a potential competitor against established investments is also temporarity removed. This identity of militarized atomics and the specific interests of big business for the present overshadows by far the demands of certain lesser or rival business circles that they be given free access to atomic "secrets" which can be employed in industry.

If, as will be shown in detail later, there is so close an identity between militarized atomics and big business, this is also due to the constant interplay between atomics and world politics. The aggressive foreign policy which burst forth soon after the war determined the military status of atomics, and the growing stock of atom bombs in turn fed this policy.

The atomic industry became a chief ingredient of American diplomacy to such an extent that even the New York *Herald Tribune,* with tongue in cheek, complained after the election of 1948 that the United States had blundered into a position in which "the atomic bomb is actually the major basis of our military policy, the chief available sanction of our security and our policy." This disturbed that sanctimonious newspaper, because the "sanction" of the atom bomb could be used only after the greatest hesitation due to the moral stigma of using such a weapon first, not to speak of reprisals too dreadful to contemplate.[16]

Notwithstanding these pangs of conscience, which did not prevent the United States from atom-bombing Japan* when she was ready to sue for peace and had no possible means of retaliation, it is a fact that the atomic weapon remains a major basis of policy, integral to the entire process of remilitarization which set in soon after the end of the war.

As long as this is the case, atomics will not be converted to peace. Accordingly, industrial application can proceed only as a by-product of the military industry, constantly limited by that factor, and developing only partially and within restricted spheres. This is established as a basic policy by the Act creating the Atomic Energy Commission:

"It is hereby declared to be the policy of the people of the United States that, *subject at all times to the paramount objective of assuring the common defense and security*, the development and utilization of atomic energy shall, *as far as practicable*, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace." (Italics added.)

As long as the paramount objective remains to develop atomic energy for military purposes, all other objectives mentioned cannot but play an incidental role, or figure not at all, in the development of nucleonics in the United States. This is expressed succinctly by the men who establish the nation's atomic policies. In discussing atomic legislation, Senator Eugene D. Millikin, member of the Joint Congressional Committee, left no doubt that civilian uses of atomic energy were to be sacrificed in the interests of atomic weapons:

"We need not push forward in those fields, I suggest, as long as the imperative overriding consideration has to do with atomic energy as a military weapon, for medicine is covered in a more inadequate fashion by existing remedies. The same use that has been suggested in the way of power is covered at the present time by, let us say, a less efficient method. Could we not lock the whole thing up, if security required it, for a year or two years without damaging our peacetime life in any material respect?"[17]

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* In his book, *Fear, War, and the Bomb*, it seems to me that Blackett has established incontrovertible evidence to show that the United States used the atom bomb against Japan in order to bring the war to an end before the Soviet forces could join the assault on the Japanese mainland, and thus assure joint rather than unilateral occupation of Japan. Moreover, this explanation is in line with the entire course of American strategy in the Pacific during the war, which was directed towards establishing an unchallenged American position in Japan and the Far East. As subsequent events showed, the devastation of Hiroshima was the blast opening the era of atomic diplomacy and the "cold war" against the Soviet Union.

Senator Tom Connally, also on the Joint Committee charged with supervision of the atomic policy in the public interest, discussed its possible constructive uses in the following terms at hearings on the atomic energy bill:

"Certainly power is secondary or 'third-dary' or 'fourth-dary' to me. I don't think that power is of any great consequence at the moment. . . ."[18]

Despite much talk from official quarters of the great peacetime potential of atomic energy, the approach remains predominantly military throughout. In the official report of January 1949, it is stated:

"The activity of the Atomic Energy Commission receiving major attention has continued to be the production and improvement of atomic weapons. This has three principal aspects: Production of fissionable material, manufacture of weapon components, and development of new designs of weapons. Important advances have been made in all these fields in 1948. The production of fissionable material is being expanded. New designs of weapons have been tested and found to be successful, and further developments are now in progress."[19]

From plans announced by the Commission for the next two years it is apparent that new development work will center on improved weapons and on stepping up the production of fissionable matter. Work on an experimental reactor for the production of electric power is still considered a secondary or, as Senator Connally phrased it, a "fourth-dary" task. In fact, in a résumé of the reactor program before the American Academy of Arts and Sciences in February 1949, Commissioner Robert F. Bacher gave the experimental power reactor last place among the four chief projects, the others being concerned primarily with increasing the production of fissionable material for weapons and with experimental work on the atomic propulsion of battleships.[20]

As a result of the violent distortion of the new industry by the war and new preparations for war, profoundly contradictory developments were set in motion. On the one hand, a great forward spurt occurred in the military application of atomic energy, developing only one area of the science and the technology. On the other hand, the growth of the science as a whole and of its application to wide areas of economic and social development have been immeasurably hampered. Atomic science in the United States is a prisoner of war, permitted only occasional but constantly supervised outings into the sunlight.

One may well ask again how different the results might be if the effort now devoted to stocking the atomic arsenal were to be turned to the production of useful power. Certainly, an industry the main product of which is electric power rather than bombs would be different in many vital respects from an industry in which the bomb is the main product and potentially useful power only a by-product. As things now stand, the industry is still in the primordial stage—an industry for mass destruction.

III. THE MONOPOLIZED ATOM

The military impediments to nuclear science, at the moment in its development when beneficial application on a broad scale becomes possible, are serious enough without the intrusion of still other restrictive forces. If atomics was born as a military industry, it also immediately became the ward of private monopoly. Its status as a national munitions industry, ownership of which resides in the federal government, should not be permitted to obscure the dominant role played within it by the big corporations, as regards both actual control and guiding policy.

THE MEANING OF GOVERNMENT OWNERSHIP

A myth has grown up that the present federal status of the industry is some manner of socialism.

The propagation of this myth from the reactionary side may be attributed to various motives. Some interests are disgruntled because they play only a minor part in the industry or are excluded entirely. Certain branches of industry expect immediate benefits from technique developed in the atomic project and are impatient at the military restrictions that prevent their use, while others seek to block these innovations because they would compete with techniques already in use and monopolized by them. In addition to these and other motives, which arise from many rivalries between branches of the economy and among monopoly groups, there is the inflexible attitude of "private enterprisers" who on principle oppose any government ownership, even if it is required by the special interests of private monopoly.

As a whole, however, the prevailing attitude of big business, as distinguished from various medium and non-trustified sectors, to government ownership of the atomic industry is determined above all by considerations of expediency. When Dewey, in his desperate search for an issue in the 1948 campaign, once raised the demand for transferring the atomic industry to private ownership, the response was so lukewarm that he never repeated it. The reason for this was, in part, political. This demand proved embarrassing to the bipartisan coalition that supported the aggressive foreign policy in view of the pretensions of the American scheme for United Nations control of atomic energy, since according to this plan ownership of the atomic plants was to be transferred to an "international" agency. Accordingly, Dewey was reprimanded by the New York *Times* for "forgetting" the Baruch Plan.

There is another, more substantial, reason for the cool reception given Dewey's electioneering proposal. Big business has everything to gain from government ownership of the atomic industry at this stage, because of its very high capitalization, and the heavy, immediately unprofitable investments in initial development and experimentation. The government bears the costs and assumes all risks. At the same time, private monopoly operates the basic atomic installations as managers and contractors. Aside from the management fees and the profits obtained from the supply of equipment to the state-owned enterprise, private monopoly obtains access to the atomic secrets, builds up its own stockpile of atomic patents, and acquires an accumulation of first-hand experience which can be applied at the first profitable opportunity.

David Lilienthal, chairman of the United States Atomic Energy Commission, discussing the present "delegation to private industry" of most of the work of the government project, summarized the benefits at a meeting of the New England Council (of big business) in November 1948:

". . . These private firms take no financial risks. Neither do they make any profit in the commercial sense. They do make an investment in people, their employes. These people become proficient in a new technology, gain new ideas adaptable to their companies' processes or products. From their new skills, in time they can expect a return. . . ."[1]

Lilienthal also explains in part why no private concern has yet proposed to build an atomic pile at its own expense:

"These reactors are very expensive experiments. To the cost of the structure itself must be added the expense involved in necessary safety and health measures, in heat transfer and chemical processing facilities, in people to do the operating and maintenance and research, and in the buildings and facilities needed to maintain the people. Altogether the cost of a reactor runs to something like fifty million dollars. The prospect of a return is remote in time, and the money risk is great."[2]

In a report made public in December 1948, the Industrial Advisory Group of the Atomic Energy Commission, while dissatisfied on other counts, endorsed the central policy. It was "generally favorably impressed" with the "practice of conducting work through private contract rather than by building up a Government force." Its most important recommendation was the proposal to expand greatly the participation of private concerns, within the existing structure of government ownership,[3] with a view to the eventual transfer of the atomic industry to private ownership, while encouraging piecemeal transfers in the near future. The Industrial Advisory Group could speak with authority as regards monopoly. Its members represent dominant corporations in the spheres of petroleum, utilities, chemicals, and power-boiler equipment.*

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* At the time the report was submitted, the members of the Industrial Advisory Group were: James W. Parker, president of the Detroit Edison Co., Chairman; Robert E. Wilson, chairman of board, Standard Oil Co. of Indiana; Bruce K. Brown, vice-president, Standard Oil Co. of Indiana; Gustav Egloff, director of research, Universal Oil Products Co., a joint subsidiary of the Shell Union Oil Corp. and the Standard Oil Co. of California; Paul D. Foote, Executive vice-president, Gulf Research & Development Co.; Isaac Harter, Sr., chairman of board, Babcock & Wilcox Tube Co. (a leading producer of power-boiler units); Jerome C. Hunsaker, chairman, National Advisory Committee of Aeronautics, and a director of the Shell Oil Co., Sperry Corp., Goodyear Tire & Rubber, and McGraw-Hill Publishing Co.; and Gabriel O. Wessenauer, manager of power, Tennessee Valley Authority. Two other members resigned before the report was submitted to accept government posts: Donald F. Carpenter, vice-president, Remington Arms Co. (a subsidiary of Du Pont), to take the post of Chairman of the Military Liaison Committee on atomic energy, from which he subsequently transferred to the chairmanship of the Munitions Board; and Oliver E. Buckley, president, Bell Telephone Laboratories, to accept a presidential appointment on the General Advisory Committee of the Atomic Energy Commission.

Nor can a basic conflict be found with respect to the general orientation for the future. The industrialists quote with satisfaction Lilienthal's remarks when the advisory group was first set up:

"It is the purpose of the Atomic Energy Commission, and I have no doubt that it is the intention of the Congress, to move away from the present Government monopoly, provided by law, just as fast as it can be done with due regard for the national security. . . . We must find opportunities for industrial participation—that is, opportunities for profit."[4]

In the speech to New England industrialists already quoted, the chairman of the Atomic Energy Commission referred to the guiding policy as a process of "the gradual de-nationalization of the atom," which would have to proceed on a case-by-case basis as opportunities appear for transferring certain areas of the government enterprise to private ownership.

There seems no serious reason why private monopoly should object to this approach, for they would hardly be interested in taking over any sector of the new industry before it becomes a profitable operation. In fact, this is already the case in certain important areas of the atomic industry, such as raw materials—which was in private hands from the beginning—and, more recently, the processing and distribution of isotopes for industrial and experimental purposes, and the fabrication of radiation-detection instruments. In addition, a number of large corporations enjoy a profitable business in supplying the atomic enterprise with equipment, in the engineering and construction of installations, and in the development of new techniques.*

During the process of gradual "de-nationalization" big business has little cause to fear that the new industry will grow out of bounds, impinging upon established corporate interests. The major monopoly groups play the dominant policy-making role within the apparatus of control. If it is sometimes found necessary to raise the socialist bogey to obtain certain objectives, this is nothing new in the history of economics, politics, or diplomacy.

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* In the speech already cited, Lilienthal referred to the fact that the problem of developing a new chemical process for the recovery of plutonium and uranium from used fuel material had been turned over to General Electric, Standard Oil Development Co., Carbide & Carbon Chemicals Corp., Kellex Corp., Blaw-Knox Co., Monsanto Chemical Co., and Dow Chemical Co. Later Du Pont was placed in charge of this project. Among other new projects turned over to monopoly is the power reactor program at the New Knolls Atomic Power Laboratory at Schenectady, which is managed for the A. E. C. by General Electric.

CONTROL BY MONOPOLY

From the liberal side, there has been either wishful thinking or confusion on the significance of state ownership. In the book previously cited, Newman and Miller describe the atomic industry as an island of socialism in the sea of free enterprise, and expect that this will lead to basic changes in the capitalist system.[5] These authors find many faults in the atomic policy, being especially critical of its military character and extreme security restrictions. On occasion, they reveal various ways in which the big corporations have gained special advantages for themselves. But somehow they seemed to have missed the central fact about control of atomic energy—its control by private monopoly.

This is not a completed process, nor have the essential relations among the various monopoly groups within the new field been finally established. Nevertheless, behind the facade of state ownership the private interests are in effective control, although the struggle among them for dominant place continues.

This situation was inherent in the organization of the new industry from the beginning. When the military were in direct control of the Manhattan District, and the basic plant and equipment were being installed, practically every phase of the enterprise was contracted out to the monopolies in the respective fields. This included the most vital operations: basic research, development work, processing of uranium and preparation of other materials, engineering and construction of the atomic piles and the separation plants, and the design and supply of special apparatus. The list of participating corporations is a roster of big business.

The important policy, advisory, and management committees were staffed largely by the executives and directors of research *of these same corporations,* alongside the military and the heads *of universities which are financed* by the same monopoly groups. The most important policy-making committees—the groups that drafted the proposals for domestic and international control, and the American delegation on atomic energy to the United Nations —were similarly staffed.*

The pattern of monopoly control established in the atom-bomb project changed little after the war, although some shifts occurred in the relative position of various corporations and monopoly groups within the industry, with corresponding changes in the personnel of the leading bodies.

In the production of plutonium, for instance, the changeover from direct military to civilian control of the government enterprise coincided with the emergence of General Electric into the dominant position, which during the war had been held by the Du Pont chemical trust.

In the sphere of research and new development, the oil trusts came to play a more prominent part. In raw materials, the copper monopolies remained uppermost as before, and continued to play a prominent part in the project as a whole. Bernard Baruch, who owes his start as a Wall Street broker to Guggenheim and Morgan copper deals, stepped aside as chief American spokesman on atomic energy at the United Nations only to be replaced by General Frederick Osborn, whose family interests are associated with the Phelps Dodge Copper Corp. The members of the Industrial Advisory Group might have been picked from among the most select entries in Poor's *Directory of Directors*, while the

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* Alternate chairman to Secretary of War Stimson of the committee appointed by the War Department to recommend domestic legislation was George L. Harrison, president of New York Life Insurance Co., one of the "Big Four." The technical advisory committee that wrote the Lilienthal report on international control included Chester R. Barnard, president, New York Bell Telephone Co.; Charles A. Thomas, vice-president, Monsanto Chemical Co.; and Harold A. Winne, vice-president, General Electric.

The American delegation to the United Nations Atomic Energy Commission, in addition to Bernard Baruch, its head, included John Hancock, partner of the investment banking firm of Lehman Bros.; Ferdinand Eberstadt, a former associate of the Dillon, Read banking house and now a leading investment broker, largely in chemicals; and Fred Searls, Jr., president of Morgan's Newmont Mining Co. In addition, the delegation was advised by "those in American industry who have made a success of atomic energy." (*New York Times,* May 19, 1946.)

Raw Materials Advisory Committee* might well constitute the directorate of a world cartel in copper and other non-ferrous minerals.

Either directly or through their corporate connections abroad, the private monopolies that dominate the American atomic industry also extended their influence to the new industry in a number of other countries. Imperial Chemical Industries, the great British trust, dominated the project in England from the start, and together with Du Pont, with whom it is associated in the world chemical cartel, also played a dominant part in the Canadian project. The affiliates of General Electric in both Britain and Canada are favored participants in both countries. A cartel underground, with the most complex ramifications on a world scale, reaches into all channels of the industry, including raw materials.

The bloc of the United States, Britain, and Canada, which has attempted to impose the American control scheme upon the world, is the parallel in the diplomatic sphere of the condominium of corporate interests which dominates the new industry in these countries, and which is now also attempting to seize control of world uranium. More can be learned about the real motives and objectives of the American scheme for world control of atomic energy from observation of the corporate connections within the new industry than from all the high-sounding phrases with which this scheme is presented to the world.

At this stage of extraordinary concentration of financial and industrial power, and moreover when the state has become so closely linked with the chief monopoly groups, it is more or less inevitable that atomics should instantly become monopolized by big business. This has happened to other new industries that arose since World War I, like the light and alloy metals, and synthetics.

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* The Advisory Committee for Exploration and Mining of the U.S. Atomic Energy Commission consisted of the following members at the end of 1948: Chairman, Dr. Donald H. McLaughlin, President of Homestake Mining Co., and recently appointed director of International Nickel; C. Temple Bridgman, consulting mining engineer of Guggenheim Bros.; Dr. Anton Gray, chief geologist of Kennecott Copper Co.; Robert E. McConnell, a former director of Rhokana Corp. (African copper); Fred Searls, Jr., President, Newmont Mining Corp., holding company for the Morgan non-ferrous metal interests, chiefly copper; Wilbur Judson, a vice-president and director of the Mellon-Morgan Texas Gulf Sulphur Co.; Everette L. DeGoyler, a petroleum geologist associated with the Dillon, Read banking interests; and Clyde Williams, formerly associated with U.S. Steel Corp., and now head of Battelle Memorial Institute, one of the leading private research organizations.

Atomics also starts right off as a completely integrated, giant industry. But it is too big in terms of initial capital investment from which no immediate returns can be expected, and too broad in its implications for the economy as a whole, for a single center of monopoly capital to handle. The fact that the atomic industry had to make its debut under government auspices, aside from the special military reasons, is indicative of the increasing use by the monopolies of the state, which they control, to exploit in their interests the tremendous economic and technological forces which have been built up.

On the one side, this reveals the basic weakness of our society —the deepening antagonism between private ownership of productive forces of tremendous potentiality and their social use—that is, their operation for the benefit of the people. The growing function of the state apparatus as an adjunct of monopoly capital only deepens this contradiction, for the state power becomes more openly an instrument of monopoly capital, which obstructs and prevents the social utilization of our productive forces.

This situation also leads to the most reactionary political consequences. This is exemplified by the total militarization of atomics in the service of an aggressive imperialist policy, itself the creature of monopoly capital. The "nationalization" of atomics provides the facade of government ownership behind which the monopolies control and direct this new industry, and utilize it to further their own aggrandizement and expansion. It is the kind of "nationalization" typical of state monopoly capital, the growth of which is a basic aspect of fascism.

Under these circumstances, the complete integration of the industry from raw materials to the end product, and the extreme centralization within the framework of government ownership, have facilitated operational control of the new industry by monopoly. Accordingly, all the restrictive and retrogressive features arising from the military status of the new industry are interwoven with the retarding force peculiar to monopoly.

These additional impediments, operating alongside military restrictions, have serious consequences. Further development is now determined in its main essentials not only by the emphasis upon military uses but also by the specific interests of the leading monopoly groups which control the new enterprise and also dominate the most important sectors of the economy as a whole. It is illusory to believe that government ownership creates an "iron curtain" protecting the new technology in any of its phases from the retarding influences of private monopoly.

THE STRUGGLE FOR URANIUM

Some significant areas have been left entirely to private monopoly, without the facade of government ownership. Aside from the peripheral spheres of isotopes and the production of instruments, the most vital area excluded from government ownership from the beginning is the mining of raw material.

In the United States, the mining of uranium ores and the initial preparation of the ores is in the hands of private companies. Only when the ore begins to move from the mine, mill, or mining field is it subject to the control of the Atomic Energy Commission. Imported ores, which play the major role in the American project, are bought and controlled by the Commission, but their production is outside its direct control.

Thus the entire field of present and potential atomic raw material is left to the established mining trusts, which now maintain what amounts to a world cartel of non-ferrous metals. Since uranium is generally found in combination with metals such as copper, silver, cobalt, and vanadium, the monopoly control already existing over these metals is automatically extended to the atomic raw material.

As yet, this is the only major sphere of the new industry that offers immediate and very lucrative profits. Even more important, control of this strategic raw material offers many advantages to a monopoly group seeking dominant place in the new industry as a whole.

As is well known, control of a vital raw material is a powerful factor not only in world diplomacy but also in influencing important sectors of the economy, and in hastening the process of monopoly. Such control is an entering wedge for this or that monopoly group into sectors of industry dependent upon the raw material as a fuel or as the essential ingredient of the finished product.

One may cite as examples the leading position of the Morgan and associated interests in the copper industry, which complements the predominance of this group in the field of electrical equipment (a leading consumer of copper); or the controlling position of the Rockefeller group in the petroleum industry whose products are vital to many branches of the economy.

The potential uses of atomic energy and its by-products extend into many industries and activities, contending as a fuel and a technology with conventional fuels and established techniques. Basic control of uranium, the prime raw material of the American atomic industry, is therefore of great strategic significance for monopoly control as a whole, as well as for military and diplomatic purposes.

Furthermore, the struggle for uranium has provided still another impulse to American imperialist expansion into newer fields, and a means of strengthening its entrenched positions in the older habitats. The American control of Congo pitchblende, through preclusive buying, has provided a new fulcrum for penetration of that continent, which is also furthered by intensive exploration for uranium sources in South Africa and elsewhere. American "scientific" expeditions roam practically at will in Africa, Latin America, and other areas in search of the "gold" of the twentieth century. United States control of Canadian uranium, which is exerted through the Canadian government, not only deprives that country of untold power resources for the future, but solidifies the already predominant position of American monopoly in Canada. Concerted efforts are also expended to establish an American monopoly of graphite, beryllium, and other raw materials used in the atomic industry.

Control of uranium already provides the chief monopoly groups with a firm foothold in the atomic industry, even without correspondingly powerful positions within the government sector of the enterprise. But these very groups already hold the vital positions in the industry. Thus the Morgan combination, which is deep in the struggle for world uranium through the copper trust, also manages the most important installations of the atomic project through General Electric; while the Rockefeller group, whose oil monopoly is affected by the new power source, has pre-empted leading positions in atomic research and development.

The Mellon interests, with extensive ramifications in light metals, oil, and electrical machinery, are also prominently represented in the research and development branches. The Du Pont chemical trust, concerned with competitive new materials and chemical processes uncovered by atomic energy, and with the competition to present explosives, has accumulated perhaps the greatest stock of know-how as a result of its leading role in the Manhattan District, and its participation in many vital operations of the present industry. Union Carbon & Carbide Corp., second only to Du Pont in the field of chemicals, is involved not only in the mining of raw materials but also as manager of the atomic installations at Oak Ridge, Tennessee, where some of the most important processing plants are situated.

MONOPOLY RETARDS ATOMICS

When monopoly groups as decisive as these are involved the uppermost tendency is to delay and restrict the application of the new technology to industry. For atomics, if broadly applied even at the present stage, may rather quickly render obsolete existing capital equipment in the generation of electric power and in certain industrial branches, place oil and coal as fuels at a great disadvantage, substantially reduce the volume of freight, and threaten a rearrangement of long-established inter-monopoly relations.

This does not mean that all atomic progress is automatically cut off; it means that the application of new techniques is slowed down by monopoly and applied very unevenly, in accordance with the specific interests of dominant business groups, and as a resultant of the competition among them. Rapid atomic progress in other countries—for example, in the Soviet Union where obstructions of this kind do not operate—may force innovations that otherwise would be smothered.

Other factors also operate that may force technological progress in atomics, despite its militarization and effective control by monopoly. Thus, largely with the aid of American capital, Germany developed far superior techniques in the field of synthetics (rubber, oil, chemicals) during the interwar years, in order to achieve self-sufficiency in strategic raw materials, access to which had been lost as a result of the first world war. Likewise, the United States developed a synthetic rubber industry only during World War II, when Japan blocked access to the natural rubber of Southeast Asia. At the same time, the United States remains backward in developing synthetic oil or gas from coal, and in deriving petroleum from oil shales, because the petroleum trust blocks these developments, while taking care to seize control of patents in this field. On the other hand, the production of synthetic chemicals from oil has become a major business of the oil trust since the war, in direct competition with the established chemical trusts.

These examples indicate some of the conflicting forces that affect the rate and extent of the application of new techniques. At present, however, there seems to be no compelling force in sight strong enough to override the natural tendency of monopoly to restrict atomics in industry.

On the contrary, a combination of very powerful factors now operates to strengthen the restrictive tendency. The first of these, as we have seen, is the aggressive and expansionist policy of American imperialism, which keeps the atomic industry militarized. Second, the combination of state ownership and private monopoly control of the industry accentuates the retarding influence of both the military policy and of monopoly capital. And finally, especially in view of the danger of an especially acute economic crisis, military atomic production for the moment helps assuage the fear of excess capacity, which in general has become an obsession in business circles.

These factors in combination explain why the maintenance of the atomic industry as a government military enterprise has proved the most effective means of monopoly control. Both government ownership and production of weapons at the present stage of atomics meet the basic requirements of monopoly. Government ownership is now economically profitable, as explained earlier, because monopoly is spared the risk of investment at the initial experimental and costliest stage of the industry. Furthermore, the emphasis on weapon production is welcomed on two additional counts: It prevents the new power source from becoming competitive with private utilities, and it postpones the increase in productive capacity that would certainly result from industrial applications of atomics.

Private capital would oppose government ownership strenuously if it were to become competitive with existing investments. In fact, there is a growing tendency in certain business circles in favor of transferring atomic production from government to private hands. This is, in part, an aspect of the intermonopoly struggle for control of the new industry, and also reflects the interest of certain branches of industry in the application of new processes developed in the atomic enterprise. Obviously, the tendency to shift the industry, or decisive parts of it, to private ownership will become more pronounced as the new technology is mastered, as the cost of production of atomic fuels is reduced, and as the implications of cheap atomic power can no longer be ignored. In the meantime, however, the contradictions implicit in government ownership of this important new industry are temporarily averted as long as the industry remains a government monopoly devoted to the production of weapons, since armament enters neither the market nor industry, as a consumer's product or as capital goods. To top this off, the aggressive policy served by atomic weapons is itself a product of the expansionist drive of American monopoly capitalism on a global scale.

It is the combination of all these factors that accounts for the "nationalization" of atomics, notwithstanding various inner conflicts and contradictions that constantly arise. The atomic industry is therefore a perfect example of a state monopoly capitalist enterprise in the service of reaction.

IV. ATOMIC POWER

Of the industrial uses to which atomics may be put, nuclear power is the most important for the expansion of the productive forces. It also seems the most feasible at the present time. It is therefore proposed to explore in this section some of the specific economic and social problems that arise in connection with the development of atomic power.

To avoid speculation as much as possible, the discussion will be kept within the bounds of what seems immediately possible and also practical, in terms of technical requirements, availablity of raw material, and cost.

IS ATOMIC POWER PRACTICAL?

Experts agree that the heat produced by nuclear fission in a chain-reacting pile can be used to drive steam or gas turbines for the generation of electricity. By this method, fissionable material would be utilized as a fuel to replace coal, oil, or natural gas in a power station. The change in technology would be limited entirely to the boiler room of the power station, with no change whatsoever in the technique or apparatus of generating electricity and transmitting it to the consumer. This may in time prove the most primitive way of using atomic energy. But for the sake of the discussion, we are accepting the assumption that more basic changes in power technology, arising from further atomic progress, will not occur in the initial stage of atomic power.

Let us first establish the fact that production of electric power in the manner outlined is technically feasible. In official reports and in separate statements by scientists and engineers, technical feasibility is not questioned, although estimates differ as to the time factor. In its report of March 1946 on international control, the Lilienthal Board stated that operating units for atomic power "can be in existence within a few years, and that *only the gradual incorporation and adaptation of such units to the specific demands of contemporary economy will involve a protracted development.*" (Italics added.)[1] The first report of the United Nations Atomic Energy Commission to the Security Council, in December 1946, stated: "Many technical problems are involved in the use of atomic energy for power, but the development seems straightforward."[2]

Also as early as 1946, it was authoritatively stated that atomic power operations were already possible. Dr. Reuben G. Gustavson, vice-president of the University of Chicago, which is the most important center of industrial atomic research, told the Senate that usable power could be produced within six months if materials were available.[3]

Professor Arthur H. Compton, Nobel prize winner and an outstanding participant in the bomb project, was also of the opinion that "*if there were sufficient demand for a demonstration,* a reasonably efficient plant using super-heated steam for driving a turbine could be put into operation within a year." (Italics added.)[4] At about the same time, Professor Farrington Daniels, who was then director of the most important laboratory of the Manhattan District, also said: "*With adequate support* a pile could be built and a good-sized turbine and dynamo could be operated with atomic power within a year." (Italics added.)[5]

With respect to the availability of fissionable material for power there was also a generally positive approach. Thus we find the Lilienthal Board stating boldly: "We see no significant limitations on this development, either in the availability or in the cost of the fundamental active materials." And the same report states: "Nor can there be much question that ways will be found to cheapen and simplify the processes involved in the production of the fissionable materials themselves."[6] Breeder-type reactors, that would build up fissionable material even faster than it is consumed and thus for all practical purposes solve the raw material problem, were also considered possible in the near future.

At about the same time, a number of independent cost estimates indicated that atomic power could soon prove economical in relation to other fuels. In September 1946, an Oak Ridge group of scientists and engineers completed a special study, which the American delegation considered significant enough to submit to the United Nations. This group showed that even at the present level of technique, atomic power would cost about eight mills* per kilowatt-hour to produce as compared with 6.5 mills for a coal-power plant under generally similar conditions. Allowing for rapid technical progress in an industry as young as atomics, this admittedly conservative estimate indicates that atomic power could become competitive with coal rather quickly. The Oak Ridge report concluded:

"On the basis of this study, and other similar studies which have been made recently, it seems probable that nuclear power will find favorable industrial application *if obstacles are not placed in the path of its development.*" (Italics added.)[7]

Another study at about the same time by a group of California scientists, under the auspices of the Carnegie Endowment Committee on Atomic Energy, came to even more optimistic conclusions.[8] They held that a central atomic reactor for a plant capacity of 500,000 kilowatts could produce power at three to four mills per kilowatt-hour, far below the cost of most coal-power stations. In addition, the new fissionable material produced in the pile could be used in secondary reactors to provide power at five to fifteen percent below the cost of a competitive coal plant. If this estimate is correct, atomic power would be competitive not only with coal but also with oil, and not very much above the cost of average hydro-electric power.†

Still another preliminary study was completed by the Cowles Commission at the University of Chicago in June 1946, but not released until a year later.[9] This study contains two estimates based on different assumptions. A rough estimate of comparative power costs, which is believed to understate the cost of atomic power for the near future, placed nuclear power at from three to five mills per kilowatt-hour, about midway between hydro and coal-steam plants. Another, and more detailed estimate, placed the cost of nuclear power within the next five to ten years at from 4.8 mills, if the plant is run at full load, to 7.7 mills, if the plant is run at half load. But a large part of the estimated costs is represented by very high fixed cost of fissionable material and nuclear reactors, both of which will cost less and less as the methods of preparing nuclear fuel are improved, and as the production of reactors becomes standardized.

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* One mill equals one-tenth of a cent.

† The average price at TVA in 1947 was 3.75 mills per kilowatt-hour, and for power supplied to industrial firms 3.17 mills. The price charged to large industrial consumers is very close to cost of production.

Thus, perhaps within ten to twenty years, according to this study, the average rate might be reduced to three mills per kilowatt-hour. In any case, even with the present high fixed costs, the Cowles Commission study confirms other estimates showing a favorable cost advantage for atomic power in relation to coal-steam power plants. Professor Jacob Marschak, head of the Cowles Commission, predicted: "Atomic energy can probably compete with coal—even in this country of cheap coal—within the decade beginning with 1950."[10]

On the basis of these and other estimates, it was reported to the gathering of the American Society of Mechanical Engineers in December 1948 that power from atomic reactors, competitive in cost with existing power plants, can be produced with little more than present engineering technology.

In view of this array of competent opinion, it is all the more surprising to find a rather sharp change of emphasis in the more recent official attitude. By September 1947, the United Nations Atomic Energy Commission in its second report to the Security Council predicted that atomic power "probably cannot become an important factor in the world's existing power resources for some decades."[11] In its midyear report for 1948, the United States Atomic Energy Commission included an extremely discouraging report by the A.E.C. General Advisory Committee on the problem of atomic power.[12]

The latter report, which must be accepted as the official position, makes one or two positive admissions, but these are instantly surrounded by a host of reservations and uncertainties. It is conceded that at the price of uranium before the war, "the cost of uranium fuel would compete with coal under almost any condition," but this is offset with a reference to "a rapidly growing shortage of uranium."

The possibility of breeding more fissionable material than is consumed in a power reactor is admitted "theoretically," but we are warned that the "engineering difficulties are enormous" and "acute." The report is replete with references to "numerous scientific and technical problems," such as had been mentioned many times before but not with the sense of defeatism and fatalism that pervades this report.

Having solved so quickly and effectively the initial and most difficult problems associated with fission, it seems incongruous for the project scientists and advisers to be stumped by engineering problems much less complex than those of constructing the first reactors of the Manhattan District.

After indicating that the most *unfavorable* technical assumptions with respect to atomic power are to be accepted, the General Advisory Committee concludes: "We do not see how it would be possible *under the most favorable circumstances* to have any considerable portion of the present power supply of the world replaced by nuclear fuel before the expiration of twenty years." If unfavorable assumptions are accepted, it might be concluded, as the British scientist, R. E. Peierls, recently said, that the atomic power age "is still in the fairly distant future, perhaps two generations off."[13]

If we take into account the immediate political-strategic background of these pessimistic estimates, we must come to the conclusion that a deliberate effort is afoot to discourage the development of atomic power.

THE URANIUM "SHORTAGE"

In the literature on the subject two uncertain elements are generally cited: One is the availability of enough raw material to assure substantial atomic power for a long time to come, and the other is the possibility of breeding more material than is consumed. The latter is known to be possible in theory. Plutonium is already being bred from natural uranium, the only question being whether all of natural uranium can be converted into plutonium instead of only a small portion as now.

Since the American enterprise is interested in stockpiling as much fissionable material as possible for weapons, a breeder program is already under way, and new reactors are being designed for this purpose. If breeding proves feasible, raw material would disappear as a limiting factor, especially since by the same process it would be possible to breed another nuclear fuel from thorium, which is more plentiful than uranium.

But even under the most unfavorable assumption—that breeding is not immediately mastered to the extent envisioned—and within the presently visible horizons of atomics, there appear no serious grounds for fearing an absolute shortage of uranium for some time to come.

Most estimates of available source ores that have appeared cannot be taken seriously. They are admittedly based on deposits as known before 1941, when strict censorship was imposed on all production and development data. The additional reserves blocked out in the pitchblende fields, the extent of new deposits uncovered since then, and the progress already made in developing new techniques for recovering uranium from low-content ores and from new sources (such as oil shales and as a by-product from gold ores) are not known. A number of new, apparently important, deposits are being worked in Canada, for example, while the Minister of Industrial Production of the Union of South Africa boasts that the country "may produce more uranium than any other country in the world." An intensive search is under way in many parts of the world, the results of which are only partly publicized.

A half-year after the Atomic Energy Commission expressed concern over "the rapidly growing shortage of uranium" as a factor limiting atomic power, another official statement was made that stands in stark contradiction. In a speech before metallurgists of the Massachusetts Institute of Technology, J. K. Gustafson, Manager of Raw Materials Operations for the United States Atomic Energy Commission, stated flatly:

"In my judgment the estimates of future uranium supplies that I have seen are far too pessimistic. . . . There will be enough source material to permit this atomic energy business to expand considerably and to go on for generations. . . ."[14]

However, there is no question but that we do suffer from a *relative* shortage. This arises from the fact that the United States now monopolizes the chief sources of uranium available to the non-socialist world, and is using this monopoly for the purpose of atomic armament. Uranium ores are being stored as rapidly as they can be obtained, and this is no doubt having the effect of exhausting the most important known sources of pitchblende—at the Great Bear Lake in Canada and in the Belgian Congo. The atomic installations at Hanford and Oak Ridge are turning out plutonium and enriched uranium day and night, and the central aim of the Commission is to expand production as quickly as possible.

The same fissionable material now being stored away in the military stockpile could be used for the production of power. If we assume that an atomic bomb contains one hundred pounds of nuclear fuel, then in every bombload stored away there is enough energy in the form of heat to run the entire power industry of the United States for almost two days at full capacity.* In the reactors now working there is enough nuclear fuel to supply the power needs of the United States for years.

Nowhere does the competition between the military and constructive uses of atomic energy stand out so starkly. For all practical purposes the so-called shortage of raw material is due exclusively to the military monopoly established by the United States. In monopolizing for military purposes the uranium supplies available to the West, the United States is also depriving other countries of the raw material for atomic power. It is a monopoly that serves both military and cartel-like aims.

Thus, it is conceded on all sides that atomic power is technically feasible. Its cost, as we have seen, presents no major obstacle to immediate development. Raw material is more than sufficient, even before breeding is fully employed, and especially if fissionable material is not monopolized for the weapons stockpile. The essential technical prerequisites would seem to be on hand to assure the most favorable conditions for the inauguration of the atomic age within our generation, that is, at least by 1970. But obviously that is not the perspective of the Atomic Energy Commission and of official policy, which assumes the most unfavorable conditions, postponing the atomic power age beyond

* At the rate of ten million kilowatt-hours of heat per pound of uranium-235 or plutonium fissioned, which is based on Smith's calculation of the energy released by every fission. Of course, heat is transformed into electricity at a fairly low efficiency. At 25 percent efficiency, which is achieved in the newer steam boilers, one hundred pounds of fissionable matter would produce about 250 million kilowatt-hours of electricity.

our generation. This official view is the outgrowth of the same national policies which led to the militarization of atomics, the active war preparations of the United States, and the resulting danger of war. As long as this remains dominant policy, it is idle to expect the United States to promote the development of atomic power on a substantial scale.

DO WE HAVE ENOUGH POWER?

In fact, official policy deliberately discourages atomic power. In an unusual survey of the atomic industry in 1948, *Business Week* found that the Atomic Energy Commission's "industrial contractors are being discouraged from putting too much effort into power," since the program is "above all things an armament program." Although competent authorities were found who were confident they could deliver a commercial atomic power plant by about 1952, this is discounted because "A.E.C. doesn't want it much."[15] It might be added—nor do the large utilities want it. The element of appeasement of the private utility interests, which is now so much a part of official atomic policy, is reflected in the following statement of the Chairman of the Commission before the Economic Club of Detroit:

"There is not any reason to expect that an atomic energy industry will spring into being overnight and make its appearance as a colossus upon the national scene, displacing at once the power industries which now serve us and disrupting in a few years the whole pattern of our economy. It will almost certainly follow the course of supplementing rather than supplanting existing economical sources of energy supply."[16]

Despite such assurances, one can be certain that private monopoly is taking every possible step in advance to guarantee its control over the rate and extent of development of atomic power. Such guarantees of control already exist in the dominant position that private monopoly enjoys within the government's atomic enterprise. Its influence here is exerted in the direction of slowing down the development of atomic power.

It is also obvious that atomic power is inevitable. Accordingly, monopoly must have assurances that it can control the application of atomic power to industry in accordance with its own interests. Therefore, as we have seen, the Industrial Advisory Group, which consisted largely of oil and utility magnates, demanded even greater participation of private industry in the government enterprise. By this was meant not only increased control over the operations of the industry, but the transfer of sections of the industry to private ownership as soon as they become profitable—and this applies above all to atomic power. As we have also seen, no real cleavage in basic policy arises on this question as between government, on one side, and big business on the other: The orientation, as Lilienthal put it, is towards the "de-nationalization" of the atom, providing of course it is also demilitarized.

In any case, the private monopolies have been sufficiently forewarned. Necessary precautions have been taken, not only in operational control but also in the sphere of legislation. Under the Atomic Energy Act, the Commission may not license the use of atomic energy for industry until Congress has had ninety days in which to pass upon the application. This provision gives monopoly an additional opportunity to protect itself against competition from untrustified sectors that may be seeking to develop industrial atomics. As Henry Wallace, then Secretary of Commerce, said at the time, this "extends an invitation to vested economic interests to bring pressure upon Congress to prohibit or delay economic progress."[17]

Overshadowing the formidable array of military and monopoly forces that block atomic power, is the omnipresent factor of overproduction, or excess capacity. Actually, despite great depressed areas like the South, there is no impelling impulse in the United States, or for that matter in most developed capitalist countries, for the rapid development of atomic power. Certainly, there is no impulse now operating in the United States strong enough to offset the restrictive forces.

During the last three decades power production in the United States increased sixfold, building up a capacity sufficient for the profitable operation of the economy even during a superboom period, and far too much for a period of depression. Within the limits imposed by the capitalist market, despite temporary moments of power shortage, there is now more than enough power to suit the trusts. In the survey already cited, *Business Week* put the matter rather bluntly: "The key fact about development of useful power from atomic energy is that no one in the United States needs atomic power very badly." No one, except the people who need the heat, the light, and the goods that can result from its abundant use. Thus, to mention only one of many items, over thirty percent of the farms in the United States, despite the boasts of the utilities that we have more than enough power for all our needs, still do not have electric service from central stations.[18] But the masters of the economy do not need more power; in fact, they fear it, in the presence of a new crisis of overproduction.

It is no doubt also true, as is often pointed out, that the reserves of coal in the United States are sufficient to supply our power needs for centuries—if one assumes that our restricted and grossly unequal standards of living will persist for centuries, that our technology has been frozen for that eternity, and that we will continue to monopolize the resources of other countries.

However, the United States cannot be taken as a model for other lands, where resources and requirements may be different in some significant aspects. Among the developed capitalist countries the same restrictive factors that operate in the United States are also present, but in some cases stronger offsetting forces may also be at work.

It has been pointed out, for example, that atomic power might provide a faster and even more economical means for extending electrification than the modernization of the coal mines, as in England, or than undertaking huge hydro works for power in other places. In countries poor in coal, or in regions remote from fuel sources, the use of atomic power would make up for these deficiencies, and would also represent great economies in fuel costs if coal or oil has to be transported over great distances. It is not to be excluded, therefore, that atomic power may develop faster in some other capitalist country than in the United States.[19] In fact, experimental work on atomic power is now said to be more advanced in Britain than in the United States, although it still remains to be seen if this will lead to the actual development of atomic power on a substantial scale.

If monopoly capital retards atomic power in the most highly developed economies, where the level of technology is most favorable to its progress, the prospects for atomic power are even dimmer in the economically backward countries under the domination of imperialism.

DEVELOPMENT OF BACKWARD AREAS

In such countries the use of atomics in economic development assumes extraordinary importance. Its value to these countries cannot be measured in terms of savings of fuel cost alone, although such economies would be much greater in Brazil or India than, say, in the United States. The significance of atomics in these countries is that it opens unique possibilities of rapid electrification, on a very flexible basis, thus providing a powerful impetus to economic development in general. The possibilities of atomics in China, India, Southeast Asia, the Middle East, Africa, and Latin America are indeed immense once the peoples of these areas follow China's example and break away from imperialism.

There is no reason to assume that the economically backward countries should have to pass through the very same stages as the older industrial countries. The United States and Germany benefited from the industrial experience of Britain and soon outdistanced her in technique, Japan learned from Germany and the United States, and the Soviet Union adopted the latest techniques and made its own basic contributions. The same can be expected from countries now standing on the verge of industrialization. In these countries, atomic energy can be applied more efficiently and more completely than in the presently developed countries, where the basic location of industry in relation to power, raw materials, transport, and markets is already established.

Requirements will no doubt vary as between countries and regions, but atomic power may well become the central source of power to industry, with hydro and coal supplementing this source where they are found economical in conjunction with other functions—such as flood control—or where coal may be needed in steel-making and other industrial processes.

It is obvious, for example, that atomic power provides greater flexibility even than coal-steam power, thus leading to more efficiency in the location of industry with respect to raw materials and markets. Atomics would also favor the adoption of the more efficient electrolytic industrial processes, which require large quantities of electricity, such as aluminum, ferro-alloys, fertilizers, and chemicals. It would also provide economies for industries that utilize large amounts of heat, like smelting, glass, ceramics, and paper.

Coal and oil resources of a country might then be developed not merely as fuels but with greater emphasis upon their function as the raw material of chemicals and synthetics, replacing products that would otherwise have to be imported or fabricated at greater expense. In short, atomics offers the possibility not only of cheap and plentiful power as a basis for rapid industrialization, but also provides new elements of significance to the entire organization of production and distribution.

These are some of the possibilities of the new power source for the development of backward countries. But their realization depends upon the transformation of present relations between these regions and the imperialist powers, as well as changes in the internal social structure where powerful remnants of feudalism prevent economic development. The principal factors that prevent the application of atomic power in the regions needing it most are the same that have retarded and obstructed the economic development of the colonial and semi-dependent countries until now.

The countries of monopoly capital will remain just as reluctant to export capital equipment for an atomic power plant as they have been to permit the export of power turbines and other machines for general industrial purposes. To demonstrate this point, one need only examine the results of decades of capital export from the United States to Latin America, the leading "colonial" sphere of the United States. These capital exports went chiefly into the sphere of raw materials, and into utilities and transport needed for the exploitation of natural resources. Of $3.5 billion in United States private investment in Latin America, only $325 million, or less than ten percent, are in industrial enterprises.[20]

With respect to atomics, the situation is the same. The only atomic interest of the United States in the backward regions is to obtain control of the sources of uranium, thorium, and other raw materials useful in the new industry, and to monopolize these for military production. Just as the United States has drained Latin America and other regions of their copper, petroleum, and other national resources, while denying them access to the means of industrialization, it is now also seeking to deprive these regions of all their atomic raw materials, while withholding from them the information and techniques they need to develop atomic power.

In general, the prospect for atomic power in the economically backward areas under existing imperialist relations is even less than the prospect for economic development as a whole. Because of the complex technology and great capital investment, a central atomic power station, to prove profitable, would require a great industrial complex to utilize its power. For similar reasons the hydro-electric potential of many colonial regions has remained practically untouched.

Besides the usual factors of imperialism and monopoly, postwar military-strategic considerations also operate to keep atomics concentrated within the established centers of industry and economic power. It may be said that just as long as world capitalist relations prevail, every great technological advance, which presents new opportunities for the rapid development of backward regions, is at the same time surrounded by ever greater obstacles to its utilization.

In time, atomics will play a very significant role in the development of the economically backward regions of the world. But this will occur on an extensive scale only as the principal colonial and semidependent countries break with imperialism and move in the direction of freedom, including basic progressive changes in their own social structure, such as are now taking place in China.

The appearance of atomic energy as a potential source of power thus instantly brings into play, on an immense and global scale, the central contradiction of our time: capitalist ownership or control *vs.* social utilization. This conflict cannot be solved apart from the crisis that confronts capitalism as a system of society.

V. ATOMICS AND THE STATE POWER INDUSTRY

Weapons production by the government-owned atomic enterprise, as we have seen, is in accordance with the most immediate interests of the dominant monopoly groups. This coincidence of government ownership, private monopoly control, and weapon production serves the purpose for the time being of delaying the inevitable competition of atomic energy with the conventional fuels and with existing power plants.

However, such competition will inevitably arise, since the appearance of atomic power cannot be delayed indefinitely. This prospect draws nearer with every increase in the stockpile of atomic fuels, which can be used for both weapons and power, and with every expansion of the atomic industry, although this is now devoted to weapons. The inter-monopoly struggle for control of the present atomic industry therefore also involves control of a new power source of great potential.

A similar struggle among monopoly groups and competing business interests has proceeded for some time for control of the hydro-electric projects, which were developed under state ownership, mostly in connection with the public works program for the relief of unemployment during the great crisis of the 'thirties. The opposition of leading private utility corporations to these projects is well known, but this should not be permitted to obscure the fact that the state power industry is controlled by and serves the interests of dominant monopoly groups. The continuous struggle among conflicting business interests for control of this new source of power takes the form of state versus private ownership, but in essence it is a struggle among these groups for control of the hydro projects, whether this monopoly control is exercised through the agencies of government or the private corporations.

This inter-monopoly struggle for control of new sources of power is now being extended into the sphere of atomics, and it is taking place within the framework of state ownership of the industry. Furthermore, it will probably continue within this framework for some time.

TECHNICAL BASIS OF STATE OWNERSHIP

The reason for this is that the peculiarities of the new power source favor state rather than private ownership. Not only would a central atomic power station require an immense investment; unlike other power plants using the conventional fuels, it would produce additional fuel, which can be used in secondary power stations. If, as a result of "breeding," more fuel is produced than is consumed in the central station, a sort of chain reaction for the production of power would be set up, in which the primary station would assume by far the decisive role in the nation's power system. As new uses are found for atomic fuel and for radioactive by-products, such as the isotopes and the radiation waves, the significance of the primary reactors within the economy as a whole would become correspondingly greater.

To these considerations must be added still another: Since the same atomic fuel may be used either for power generation or for weapons, a primary reactor is both a power furnace and an arsenal. This double function of a primary reactor is an important factor making for state ownership, as the best means by which the leading monopoly groups can dominate atomics in accordance with their major political and economic objectives.

If nuclear fuel produced in government-owned primary reactors were to be supplied under federal controls to privately owned secondary reactors (which cannot produce additional fuel), the technology is such that it would seem impossible for the private sector to exceed the output of the state sector. For unless the energy of the government-owned reactors is to be entirely wasted, the central stations would have to produce at least one kilowatt for every kilowatt produced in secondary power stations. This situation is always potentially present, even if government reactors are limited for a time to the production of atomic fuel for weapons as their central function.

Even if power were to be kept to a secondary function, it would immediately assume large proportions in the operation of central piles. Like hydro projects—where power is considered secondary to flood control, irrigation, water supply, control of stream pollution, or navigation, as the case may be—the atomic reactor can have multiple functions. It may be constructed to emphasize one or more of these functions, whether it be producing fissile material, isotopes as research tools or for industrial uses, radiation for therapy and industry, or energy for space heating, industrial processes, and power. But the fact remains that the power potential is always there, and is always very great.

In this respect, there is a direct analogy with TVA, the prime function of which was supposed to be flood control and promotion of inland navigation. Generation of electricity is a secondary function, subordinate to the others. Nevertheless, TVA produces more electricity than any other single power system in the United States.

Once the economy and efficiency of atomic power have been demonstrated, it would become increasingly impossible to continue wasting the power potential of government atomic reactors, just as it was impossible to permit the power potential of a head of water in a large dam to remain dormant, once the economy of hydro was proved. In a central power station, a ton of enriched uranium would provide at present efficiency about six billion kilowatt-hours of electricity, and also at least enough plutonium, easily transportable, to supply an equal amount of power elsewhere. In the very same process, the original material would also produce about a ton of new radioactive matter, and additional energy in the form of immense quantities of radiation.[1] This potential is of a magnitude, invoking a multiplicity of applications, which may best be handled by monopoly through government agencies.

In sum, the characteristics of atomics are such as to promote a situation in which the cheaper forms of power—nuclear and hydro, both of which are self-renewable—would be largely in government hands. At the same time, power derived from the conventional fuels, which are exhaustible and moreover face mounting cost disadvantages, are now chiefly in private hands. The private utilities are certainly discouraging such a development, which would not only cheapen existing investments but also contains the possibility that more powerful monopoly groups whose prime interests may be in cheap power and munitions would utilize their favored position within the expanded state power industry to seize new points of vantage at the expense of the old-line private utilities and the monopoly groups most closely identified with them.

STATE HYDRO PROJECTS

Considerable light on the state aspects of atomic power, and the nature of the conflict involved, is provided by the government-owned power industry, which is largely hydro-electric.

The hydro projects were the outstanding example, before the atomic industry was established, of state-owned enterprises. Certain basic characteristics of this development illuminate the problem of state atomic power, and of capitalist state ownership in general.

The immense hydro works have multiple functions—irrigation, flood control, water supply, inland navigation, conservation of natural resources, and rural electrification. These functions entail extensive changes in the topography and organization of entire regions, such as would not be undertaken by private monopoly, since no immediate return in the form of profit on total investment can be obtained from these undertakings. Very large investments are involved. Thus, up to the end of 1948, over $700 million was invested by the Federal government in TVA, and only a portion of this investment proved profitable in the narrow and immediate sense.

Regional and specialized business interests are able to enjoy the advantages of these government works without risking a penny of their own capital. These advantages include improved and cheaper inland navigation, lower electricity rates to industries in which power is a substantial ingredient of cost of production, and, as in the West, cheaper irrigation and power for the large factory farms. Furthermore, these state undertakings provide certain opportunities to some big business groups or centers of monopoly with specialized regional interests, as well as to newcomers in the ranks of big business, to challenge the position of the established or rival groups of monopoly capital.

In illustration, one may mention the efforts of certain regional monopoly groups in the West to exploit the state projects in their competitive struggle against the dominant group in this region—the Giannini banking group, the Southern Pacific Railway, and the utility empire of the Pacific Gas & Electric Corp. In connection with the important role that considerations of cheap power play in certain industries, one may note the advantages accruing to the aluminum trust and certain chemical and refining corporations from TVA and public power projects in Canada. Where navigation is concerned, important mid-West business groups benefit from the waterway now available through the Tennessee Valley to the Mississippi as a result of TVA. One of the most illuminating illustrations is the support now given to the projected St. Lawrence Waterway by the Cleveland steel interests, which have recently acquired large iron-ore deposits in Labrador and Quebec, and seek a cheap water route from these raw-material sources to their steel furnaces.

These huge hydro projects have therefore received support from significant sectors of big business, while they have been generally opposed by the utility magnates and, in cases where their interests are affected, by the railroads. It often happens that these conflicting interests operate within a single sphere of monopoly-group control, and not only between various sectors of big business. Production as a whole has become ever more complex, while its various sectors may be parceled out among various centers of financial control. Power cuts across many of these economic interests. Therefore it has been possible for hydro to come forth as a state enterprise out of this mesh of conflicting and intertwining interests, which seek a certain degree of accommodation through the state apparatus, within which the inter-monopoly conflicts continue, and the basic interests of monopoly are served.

As a result of this situation, hydro has not been developed in our country to anywhere near its full potential, although it is capable of playing a very significant role in the development of entire regions.

This is reflected in the relative position of fuel-burning plants and hydro in the power expansion of the past quarter-century, when electricity became the main motive power of industry. Between 1920 and 1947, the amount of electricity generated from fuel, mostly coal, rose by seven times, while the current generated from hydro rose by only five times.[2] Obviously, hydro cannot replace all other available sources of electricity, but this relation over the period of great power development, despite the cheapness of hydro as compared to coal plants and the vast untapped or only partially used water power available in the country, indicates how the state power industry has been limited by the private utilities.

Furthermore, the state power industry has been accommodated to the specific needs and interests of various monopoly groups, including the private utilities. This may be illustrated by the distribution of electricity from the principal government-owned hydro works.

Thus, of the total power generated by TVA in 1947, twelve percent went to Aluminum Co. of America, twelve percent to private utility systems for distribution, 35 percent to other industrial firms and to federal agencies (mostly, no doubt, to the atomic enterprise at Oak Ridge), and thirty percent to municipalities and consumer co-operatives.[3] It appears that as much as half TVA's power may have been turned over to private companies and at prices well below those charged municipalities and co-operatives. Of the total power turned out by the fifteen projects of the Bureau of Reclamation in the West,[4] including Grand Coulee and Boulder Dams, thirty percent was turned over to private utilities for distribution to the consumer, three percent went directly to consumers, and sixty-seven percent was sold to public agencies and co-operatives, many of the latter being dominated by corporate farm interests.

ROLE OF STATE REGULATION

Hand in hand with the growth of hydro power, there were established certain measures of regulation of the power industry as a whole through the state. These measures include regulation of prices for utility services and a degree of state supervision over the corporate structure of the private utilities, through such agencies as the Federal Power Commission and the Securities and Exchange Commission.

The function of price regulation of utility services is primarily to lessen the cost competition between the cheaper government hydro plants and the private coal-steam plants, at the expense, of course, of cheaper power. Supervision by state agencies over the utility corporations arose in part from the demand of investors for protection from the holding-company system through which the utility magnates with a small investment of their own are able to control entire utility empires. These state measures failed to eliminate the holding company as a device for the pyramiding of corporate interests, or to halt the underlying process of utility trustification, and the control over vast utility empires by a few groups of monopoly capital. Actually, these agencies of regulation serve as mediums through which the various monopoly groups, more or less in the fashion of cartels, attempt to maintain a certain balance between the state and private utilities, and also attempt to accommodate conflicting interests among themselves, although this inter-monopoly rivalry continues also within the framework of the state regulative agencies.

From this brief examination of some of the characteristics of hydro power, certain conclusions can be drawn with respect to atomic power, and to state enterprise in general. If the history of government hydro is any guide, it is theoretically possible to develop state atomic power in the United States, providing, of course, the basic obstacle of its militarization is overcome. It would suffer from the same limitations and distortions as government hydro undertakings, and perhaps more, because of the direct military uses of atomics, and its multiple application to industry, science and medicine.

However, state atomic projects would not cancel out the basic market forces that in the final analysis determine the rate and the limits of industrial application of atomics. The same contradictions of the capitalist market, which now result in excess capacity of power production, would apply to atomic power whether it is owned privately or by the state. For state ownership is erected on the foundation of capitalist society, and therefore cannot negate or override the basic nature of its operation. As in the case of hydro, the government may undertake certain regulative functions, and even continue to maintain formidable barriers to the application of atomics to industry, in line with the basic interests of the major monopoly groups and in fulfillment of a central policy. But even these regulations and restrictions, although they may be relaxed under other conditions, must operate within the confines established by capitalism, and may even become increasingly difficult to maintain in the face of many contradictory and conflicting forces at home and on a world scale.

The growing role of the state in the capitalist economy, then, has nothing in common with social planning, in the sense in which we use that term to describe the process by which an entire economy is directed and developed, as under socialism. Since state intervention or regulation, including ownership of various enterprises, proceeds on the basis of capitalism, and in accordance with the interests of the dominant monopoly groups, it must operate within the framework of an essentially planless system of production and also within the scope of the existing corporate structure. The state may perform certain important regulative and police duties in the interest of monopoly, but this becomes a function of the closer fusion of monopoly and the state, and therefore an instrument for the cartelization of the economy. State regulation is merely an aspect of state monopoly capitalism. It cannot overcome the clash of conflicting and competitive forces that determines the operation of the economy.

For these reasons the development of state atomic power, although it may be delayed for some time yet, can provide no solution to the central problem symbolized by atomics: the inability of capitalist society to utilize the immense productive forces of our time for the benefit of the people.

VI. BASIS OF ATOMIC COMPETITION

International atomic competition is seen in the United States almost exclusively in terms of an armaments race. In its crudest form, the prevailing approach seems to be that the nation possessing the largest stockpile of atomic weapons is assured decisive superiority in a world conflict. Whether expressed in this blunt form or not, it is the theory that underlies the militarization of atomics in the United States.

MYTH OF THE ABSOLUTE WEAPON

Protagonists of this view also generally assume the inevitability of war between the United States and the Soviet Union. This is a doctrine of warmakers, often exposed as such by the Soviet Union, whose spokesmen have constantly advanced the policy of the peaceful coexistence of capitalist and socialist countries. Nevertheless, the theme of inevitable war has been used in our country as a pretext for rapid rearmament and for the entire policy of the "cold war," under cover of which American monopoly seeks world domain.

The propagandists for this doctrine do not appear disturbed by the deep contradiction in their own theories. In their reliance upon the atom-bomb monopoly, they adopt purely technical and military norms to prejudge the outcome of an imagined conflict between two antagonists, who above all others represent the main contradictory social and historical forces at work in the world today. This is a competition between the historically obsolete and the historically necessary, which can proceed without war, and in which the issue cannot be drawn only as between the United States and the Soviet Union. Socialism will prove just as historically necessary in the United States for the fundamental solution of the contradictions of our society, as it proved to be for Russia and more recently in Eastern Europe.

Atomic bombs, or other weapons, cannot settle this issue, although their criminal use may accelerate the disintegration of capitalism, just as World War II led the peoples of Eastern Europe to make the turn to socialism, and brought capitalism in Western Europe to the brink of total collapse. The danger of war arises from the world expansionism today characteristic of American imperialism, and not from the competition of social systems.

Even from the viewpoint of military science alone, many questionable assumptions lie at the heart of the atomic stockpiling policy. The most pernicious of these is the assumption that superiority in a single branch of weapons, even of extraordinary destructive power, can compensate for lack of development of other arms, for an erroneous strategic concept, for a fundamentally unjust policy in a war, or for fatal weaknesses in the economy and in the social structure. It is another expression of the same "fetish of technique" of which we spoke earlier, the belief that technological superiority alone can provide the decision in the competition of nations and societies.

In his book, Blackett demonstrated effectively the fundamental error of the official American policy.[1] By an exhaustive study of the role of strategic bombing in World War II he shows that American atomic policy is erected on an untenable military strategy, which overemphasizes to the point of complete distortion the significance of air-bombing in total warfare. He holds that the greater destructive force of an atom bomb, as compared with the most formidable conventional bombs used in the war, does not compensate for the distortion of military strategy arising from undue reliance upon attack from the air. In puncturing the myth of the absolute weapon—a myth that must be disposed of anew with the appearance of every new weapon—Blackett exposes the fallacy of the military assumptions that serve as the foundation of the atomic policy of the United States.

He also shows that the American scheme for world atomic control is not only predicated upon the military use of atomic energy, but also arises from a negative approach to the development of atomic power. While he does not see eye to eye with the Soviet control proposals as submitted to the United Nations, he does show that the Soviet plan sets as its aims the maximum development of atomic energy for industry, in accordance with the developmental needs of the Soviet Union.

In presenting these contrasting atomic policies, Blackett has differentiated clearly between the two main lines of policy in the world today. His book substantiates the conclusion that the world control scheme of the United States may meet the strategic requirements of the prime imperialist power, already surfeited with more productive capacity than it knows how to use, but fails at any point to provide either security or the assurance of economic development to the greater part of the world. Quite to the contrary, the American scheme would maintain the supposed American atomics monopoly, while perpetuating on a world scale the impediments to the constructive use of atomic energy that are inherent in the entire organization of the industry in the United States.

COMPETITION OF SOCIAL SYSTEMS

It is not our purpose to pursue further the problems of control and of military policy connected with atomic energy. Instead, we wish to go on beyond the conclusions that can be derived from Blackett's book.

If it is agreed that armament alone, including atomic weapons, is not an absolute measure of victory, but is itself a derivative of more fundamental factors, what then is the basis of atomic competition?

It is this: The system of society which can make the maximum constructive use of atomic energy, alongside other significant technological innovations, will emerge the victor in the fundamental historic sense of demonstrating the superiority of one social system over the other.

The use of atomics, as of technology in general, serves as an indicator of the vitality of society. Obviously, a society that can master new techniques for constructive purposes has much more to offer the people of the world than a society that has developed atomics principally for destructive purposes. Undoubtedly, the Soviet Union has not neglected the military side of atomics, since defense remains a prime necessity. But, as a number of observers have already remarked, the Soviet Union has the necessary technical prerequisites and, above all, the essential social organization for the most effective application of atomics to its economy.

How intensively the Soviet Union may be developing atomics at the present time is not known, although Soviet spokesmen have at various times indicated that the ground covered in the United States has been mastered, and that Soviet science has proceeded further. Nor is it known how extensively the Soviet Union may be prepared to apply atomics to industry and transport, once the necessary techniques for large-scale utilization have been developed. The application of atomics would be approached in accordance with the established principles of Soviet planning. Capital expenditures for atomic development would necessarily have to be considered in relation to capital investment in the various economic sectors, and to the relative efficacy of various technologies, in the attainment of the given goal of a period of planning. Many other elements entering into the balance of the economy would also affect the rate of atomic development. In any case, once the Soviet Union is ready to use atomics on a substantial scale, it can do so more rapidly and more effectively than any other country.

One may cite, for example, its need for more power to expand production, which may indeed become the most vibrant force making for the rapid development of industrial atomics. New and cheaper sources of power, in addition to those already utilized, would be helpful in accelerating the advance to communism, which would require a large increase over present per capita production. This has been placed as the central economic task of Soviet society. If Soviet industrial production is to be increased threefold over the prewar level some time during the decade of 1960, as indicated by Stalin in his first postwar planning speech, obviously one of the prime necessities would be to expand the output of power at the required speed. Atomics, alongside new hydroelectric works, can be used to expand the existing power grid, and to reduce dependence upon coal and oil as power fuels.

As we have seen, atomic power presents unique opportunities for building up undeveloped regions, for increasing productivity, for introducing new industrial processes and materials, and for accelerating industrial expansion in general, all of which are central aims of Soviet planning. In addition, because of the heavy demand placed on transport over great distances and the need to expand transportation to keep pace with the contemplated rise of production, a vital impulse is also at work for the development of atomic propulsion. Motives and impulses there are in abundance for using atomics to smooth and shorten the road to the goal of communism, which means abundance and greater leisure for the people.

However, it is not the absolute need for more production but the ability of Soviet society to attain it for the benefit of the people on an ever ascending scale that marks the essential difference between the Soviet Union and capitalist countries. Absolute need there is everywhere, in the developed capitalist countries as well as in the economically backward and colonial economies. India, for example, stands in much greater absolute need of power than the Soviet Union, but it cannot reasonably be expected to develop atomic power on a significant scale because of the restrictions imposed by its own society and by imperialism. The unique characteristic of the Soviet economy is that it is *free* to develop, without the restrictive features characteristic of monopoly capital and imperialism, and that it is impelled by its very socialist structure to develop at the maximum rate allowed by available resources, at all times and constantly.

In the United States the chief impediment to the constructive application of atomic energy is not the abundance of other forms of power. It is the contradiction between the private ownership or control of the basic means of production and their utilization for the benefit of society. It is this contradiction that prevents the satisfaction of the people's needs in an absolute sense, the incentive to production being profit and the limits of industrial expansion for a given period being established by the saturation of the capitalist market.

While the market may continue to expand over a period, its growth never corresponds for long to the growth in productive forces. This is due to capitalist exploitation, which deprives labor of a substantial part of its own produce, the part realized as profit. Therefore, demand is relative and sporadic, limited at all times by the restricted purchasing power of the people in relation to the productive forces of the country, governed by extreme inequality in the distribution of income, and subject to the constant anarchy of capitalist production and the violent gyrations of boom and bust.

Supply, in turn, is determined primarily by the profitability of the market, and not by the actual and potential resources at the disposal of the country, although these necessarily place certain limits upon production. These central contradictions, now accentuated to an unprecedented degree as a result of World War II, delay and distort the peaceful application of atomics in the United States.

In the Soviet Union the central contradiction of capitalist society has been resolved by liquidating private ownership or control of the basic means of production and of other vital economic operations. Private capitalist ownership and control is replaced by socialist state ownership on behalf of society as a whole, where the coming to power of the working class assured the basic change-over from capitalism to socialism.

As a result of this transformation, the demand for goods now becomes constant and insatiable, the only absolute limit being the resources at the disposal of the country in terms of raw material, technology, and labor, with relative limits established by the needs of defense and of capital investment to assure future development. Social demand is now free to express itself without the encumbrances and obstacles created by the capitalist market. The need of the people thus becomes the greatest stimulus to the expansion of productive forces, which also results in lessening the burdens of labor.

Resources being limited in relation to the needs of the people, the inevitable tendency is to extend the efficiency of production and the productivity of labor. The insatiable market of socialism acts as a constant goad on technique. And since the standard of living depends directly upon the productivity of labor, the initiative of the workers is constantly exerted to prevent technological inertia from setting in for long in any vital sector of production.

When we come to examine some specific aspects of the application of technique, the real advantages enjoyed by the Soviet social system stand out even more sharply. A new technology as significant as atomics demands vital adjustments, whether in a capitalist or in a socialist society. But here the analogy ends. The process of "adjustment" is quite different. In fact, the term can hardly be applied to capitalism, since the process by which the economy absorbs new techniques can hardly be considered an adjustment in the planned sense, but is rather the resultant of a number of uncontrolled conflicting tendencies and forces.

Even with the high level of concentrated production and centralized financial control characteristic of monopoly capital, technological changes are determined primarily by market conditions, that is, by the prospects of increasing the rate of profit. Technical progress may also be stimulated by competition among branches of industry, by rivalry between monopoly groups, and by the conflict between big and medium capital. But the impetus arising from an expanding market is always followed by the opposite influence of a contracting market, while the stimuli provided by competition for profit are increasingly offset by the mounting restrictive tendencies associated with monopoly, whether acting alone or in close association with the state. The higher the level of monopoly, the more static the economy tends to become, the more rigid the systems of technology.

In the Soviet Union the introduction of new techniques and the adjustments necessitated by them are central functions of the accustomed process of planning, and not functions of the market or the accidental resultant of conflicting forces.[2] Socialist ownership makes planning on a grand scale possible. The introduction of new techniques can now be weighed in terms not only of immediate or sectional gains but also for an entire industry, region, sector of the economy, or the country as a whole over a given period of years.

As a result, the Soviet Union enjoys much greater freedom and flexibility in the exploitation of new techniques than our country. Whereas we are handicapped by numerous obstacles—such as vested interests in obsolete techniques, monopoly control of entire economic sectors and of regions, and the curse of "excess" capacity—the Soviet Union can utilize atomic power or atomic propulsion in accordance with established economic goals, and the resources and skills immediately available.

It has problems of another kind—such as the need to maintain a balance among the various sectors of the economy, so that one should not lag behind the other and thus endanger the success of the entire plan. But it has unlimited freedom, in comparison with our parcelized and monopoly-ridden economy, to solve the kind of problems that must necessarily arise in connection *with important new techniques.*

High costs involved in reorganization of modern techniques, or in the establishment of new industries and the development of new regions, can be more easily absorbed when the frame of reference is an entire economy, or an entire sector, rather than the profit expectancy of this or that monopoly group. Socialist planning also provides immeasurably greater flexibility in the location of industry in relation to power, raw materials, regional or all-Union needs, than in our country where great rigidity prevails as a result of long-established private capitalist control. A new technique like atomics, which cuts across a number of basic economic sectors, can be utilized alongside existing methods and processes to obtain the given objectives of the plan, and not in competition with older techniques.

The function of planning is not only regulative or managing. It is a dynamic force, operating at all levels from the workshop to the top planning bodies, to achieve the aims of socialist development for a given period. New techniques serve not only the immediate objectives of a five-year plan, but also the aim of an historic period of development. Thus, the First Five-Year Plan had the aim of building socialism, and subsequent plans sought to strengthen socialist society and prepare the transition to communism. The latter is seen as the next stage of socialist development, the stage where each will receive according to his needs. Above all, this requires higher levels of productivity, and therefore constant technical progress. Accordingly, the impetus for technological progress shows no sign of slackening, but is a constant factor in Soviet society.

UNDERESTIMATION OF SOVIET SCIENCE

It is still the fashion in some circles to underestimate Soviet science and technology. Before reaching the present level of economy, it is of course true that the Soviet Union, starting from a low level of economic development as compared with the leading capitalist countries, had many difficulties to overcome in the sphere of technique and labor skill. The magnitude of the Soviet achievement[3] can be seen from the following:

First, on the eve of World War II the gross output of large-scale industry in the Soviet Union was about twelve times greater than the output in similar branches in the old Russia in 1913, before World War I. Between 1928, when the First Five-Year Plan began, and 1940 all industrial production increased six and one-half times, and machine production alone ten times.

Second, the Soviet economy was able to supply weapons, in quantity and quality sufficient to defeat the most formidable array of armed might yet brought against any nation. This was done despite the fact that industrial capacities accounting for over sixty percent of total output were destroyed or halted at the height of the Nazi invasion, while lend-lease goods amounted to no more than four percent of the Soviet output during the period of the war. After this titanic struggle, with millions of Soviet dead and widespread devastation, the country turned to reconstruction and further development so rapidly and so successfully, that according to present achievements the level of output in 1950 will be at least half again as great as on the eve of the war.

Third, at the rate of development maintained throughout the Soviet economy since 1928, and during the war in the uninvaded regions, the Soviet Union is in a position to attain its goal of surpassing the present rate of production in the United States some time during the decade of 1960.

Obviously, achievements of the magnitude already to the credit of the Soviet Union would have been impossible without the development of superior techniques and skills. Nor can the goal of the next decade be attained without their constant perfection. Improvement of technology has always held a high place in the Soviet five-year plans. An authoritative account[4] of the current postwar plan places special emphasis upon mechanization of production and expanded electrification. Among the new techniques stressed are the utilization of chemical, electrolytic, rocket, atomic, and infra-red processes in production. Also emphasized is the further development of the transmission of high-tension direct current over long distances, of synthetics, and of radar and television.

It would appear then that there is not a single technological field opened in the United States that is not also being intensively developed in the Soviet Union. Furthermore, Soviet scientists and engineers are acquainted with the most complex techniques. As is well known, during the war the Soviet Union was already making a special radar transmission tube and also had a synchotron in operation for atomic research, at a time when these still were the subject of highly secret research in the United States.[5] Even without the abundant evidence of the excellence of Soviet technology in other branches as well (as in steel-making, synthetics, and power), one must conclude that the United States cannot claim any decisive advantage which the Soviet Union could not soon overcome.

Therefore, more or less equal qualitative conditions in the sphere of technique as between the United States and the Soviet Union must be assumed.

The United States has an important quantitative lead, which is part of its present priority in the magnitude of production in general. But this lead tends to become less important as the productive forces of Soviet society expand at a constant and high tempo in response to the inherent needs of socialism, while the rate of application of new technique in the United States tends to rise and fall with the economic cycle. Furthermore, since the peak of war production in 1943, and despite the high level of the first postwar economy as compared with the prewar years, the overall movement of the American economy has been downward, recalling the similar movement at a much lower economic level of the thirties, and accentuating again the features of moribund capitalism. A new crisis of overproduction, which seemed already to have set in by the end of 1948, would not only greatly reduce the magnitude of American production, but would also put new brakes on the development of technology.

Even under the best conditions, much of our technical know-how is locked away in a stockpile, which our gyrating economy and the monopoly controls permit us to use only sparingly in relation to real need and absolute demand. Moreover, new techniques are not used to their full advantage in our monopoly-dominated and chaotic economy, whereas the technology put in place in the Soviet Union is employed more rationally and to fuller advantage as a result of social planning. In our country the tempo of technological development slows down, while in the Soviet Union the tempo increases.

Accordingly, the quantitative lead now enjoyed by the United States is only temporary and relative, while it can claim significant over-all superiority neither of technological know-how nor of science.

"TECHNOLOGICAL" UNEMPLOYMENT

By the very same process of planning that determines the rate of utilization of new techniques, the Soviet Union can also make the social adjustments necessitated by technological changes. Labor displaced by more efficient machines and methods in one sector of production can be absorbed in others, while the training of workers for new skills in accordance with the newer technology can also be provided as part of the planning process. Changes in capacity resulting from new techniques can be adjusted in relation to the general balance of the economy, which the plan seeks to maintain. In brief, neither "technological unemployment" nor excess capacity in relation to the market, appear as problems in a society in which maximum production and full employment are inherent.

With us the situation is quite different. Technological progress increases both our capacity to produce and the productivity of labor. But by the same token it also accentuates the critical elements of our society.

Increased capacity widens the gulf between our productive forces and the purchasing power of the people. By and large, greater labor productivity has a similar effect, for only a very small part of the resulting benefits are realized in higher wages, the extent depending upon the strength and militancy of the labor unions. The greater part is appropriated in the form of higher profits, so that consuming power continues to lag behind the rise in productivity.

These elements of crisis are accentuated by other factors associated with improved techniques. One of these is the growth of monopoly, which is favored by ever more complex techniques that result in the greater integration of industrial production, and require huge capital investments. The competition among ever larger units of monopoly, and between trustified and medium or small business, is thereby sharpened, to the disadvantage of the latter. As monopoly grows, the tendency becomes more pronounced for the level of production in the decisive sectors, which are the most highly trustified, to be regulated downward, while prices are maintained at high levels. As a result of this and the ability of monopoly to act over large sectors of the economy, a drastic drop of production rather than "moderate" recessions is likely to develop when the market is saturated.

The more we perfect our machines, the greater also is the resulting displacement of workers, not only from labor-saving processes but also from the increased speed-up which is usually associated with new techniques. For mass-production methods based on new techniques facilitate systematic speed-up, while those sectors of industry, thrust into an unfavorable competitive position by new machines and materials in other sectors, attempt to overcome the disadvantage by increasing the exploitation of the workers through speed-up.

Displacement of workers by labor-saving machines and speed-up had already become a serious problem in the American economy before World War II. During the decade of the twenties there had occurred for the first time in the United States a decline in the number of productive workers employed in industry, despite a great rise in the volume of production. This tendency continued through the thirties, although the stagnation of techniques during the great crisis slowed down the pace of labor displacement by machines. And during World War II, industrial employment increased at about half the rate of the increase in the volume of industrial production. The full effects on the labor force of the new technology introduced during the war and the period of postwar re-equipment of industry is already becoming increasingly apparent in terms of large-scale part-time employment and lay-offs, which swell the new mass army of jobless workers now again appearing in our country.

The labor-saving aspects of atomics are not yet fully apparent, since the new technology is only in the initial stages.

But as far as one can judge, atomic power would at first affect most directly coal production and coal transport, especially by rail. In both coal mining and railroads, mechanization and competition from newer fuels or other means of transport have already played havoc with the labor force. As applied atomics extends to other branches of the economy, while continuing to cheapen and expand electrification, this will increase the elements of social disturbance arising from unemployment and crises, as well as from the sharpened competitive factors of the economy. New obstacles to atomic technique would be created. Thus, chiefly by contributing to the growth of monopoly and of excess capacity, atomics helps erect obstacles to its own development.

These then are the grounds upon which the two systems are being tested in the sphere of atomic energy, as in the entire sphere of social development.

The competition cannot be reduced to the level of an armaments race, for a weapon is no stronger than the social system that produces it, and is no more effective than the policies that determine its use. In devoting its major energies in the field of atomics to stocking the atomic arsenal and to the search for a superbomb, the United States may already have lost the competition in the larger field of atomics, as in the social utilization of techniques in general.

VII. CHALLENGE OF ATOMICS

The challenge of atomics comes neither from abroad nor from "atomic spies" within. It is created by the deep conflicts of our own society. If we use this new wonder of technology for destructive purposes, we deserve and will enjoy no better fate than Hitler Germany. If we are unable to turn it to positive benefit, the decay will have eaten more deeply into our society. This dilemma can be solved by socialism, which alone provides the foundation for the positive outcome of atomics.

Atomics is a symptom of the general crisis of capitalism in most of its aspects, because of the unique circumstances of the birth and initial development of the new technology. It was born as a war industry, at a moment when the war itself was leading to a situation in which the United States emerged as the prime imperialist power. In the policies of monopolistic aggrandizement, strategic expansion, and support to world reaction which now came forward, atomics in the form of the bomb played a central role. Atomic diplomacy became the epithet most frequently hurled at American imperialism, as it sought to exploit its mastery of the new weapon, alongside its industrial supremacy, to attain its own ends within a generally weakened and contracted capitalist world, while endeavoring to contain and undermine the growing socialist and socialist-going sector of the world. Thus, the atomic weapon became an instrument in a twofold policy, on the one side, of anti-socialist encirclement and, on the other, of the subordination of other nations to the United States.

It is worth recalling that the United States could establish its atomic lead because it was fortunate enough to escape most of the horrors and destruction of war, while serving principally as an arsenal for other nations. Secluded from the theaters of war, it could gather to its secret bomb project scientists from many countries (while Soviet scientists were meticulously excluded), and employ a portion of its great capital accumulation to engineer on a grand and lavish scale the scientific discoveries already on hand. This advantage, gained primarily at the expense of others, was turned into a temporary weapons monopoly. The dominant imperialist position of the United States is utilized to buy up scientists abroad, to drain atomic raw materials from the richest sources of supply, and to build up a store of nuclear fuel—which serves as an armament stockpile, and also as a means of hoarding material that might otherwise be used for constructive purposes.

Thus, the first great contradiction presented by atomics is between the destructive and positive use of our immense productive forces. At its moment of birth, the unlimited power potential of atomics, one of the greatest scientific and technical attainments of recent times, was choked off and diverted to military purposes. Paeans of praise to the bomb, to which we were so widely treated after its first awful descent upon Japan when that country was on the verge of surrender, and the present adoration in leading quarters of the new weapon of mass extermination, reveal with startling clarity the depth of the moral crisis that has seized hold in our country, the stronghold of world capitalism.

Scientists were among the first to grasp the full significance of this first application of atomics. Many among them felt that by the act of Hiroshima the great positive potential of atomics had been stifled for the time being. They experienced the frustration that possesses men when the values and morals they have learned to respect suddenly lose validity, and they see only the prospect of senseless devastation ahead. Many came forth valiantly in the struggle against continuing military control of the new industry, which was in reality a struggle for the conversion of atomics to peace. Only in form was this struggle won with the establishment of civilian control. In essence the industry remained military, and was chained to a warlike policy, because in the midst of the fascist-type anti-Communist crusade that had been let loose in our country, the people had not fully understood the urgent need and had therefore not yet undertaken the struggle for peace.

Anti-Soviet incitement served as a facade behind which the new industry was harnessed within a military and monopoly straitjacket. Untold harm is thus inflicted upon atomics, both as a science and a technology, at a time when its constructive development promises to provide within our generation limitless useful power to a world so urgently in need. This distortion of our productive and scientific attainments proceeds side by side with the political misuse of atomics by reaction to threaten our liberties and the peace of the world.

Atomic scientists in the United States must bear their share of responsibility for the violence done to peace. A number of leading scientists of the wartime project favored the use of the atom bomb against Japan on the plea that it would shorten the war, although responsibility for the decision rests in Washington and it was obviously taken in furtherance of the political objective of gaining sole American supervision of Japan, when it was already known that the Soviet army was about to launch its devastating blows against the main concentration of Japanese forces in Manchuria.

Nevertheless, many scientists, overcome by alarm at the destructive power of the bomb and desiring to warn the people of the dangers of another war, actually played into the hands of the warmongers by helping create the myth of the absolute weapon with their fearsome exaggeration of the new explosive power, out of all proportion to the realities of world politics and of modern warfare. It was precisely this fear, deepened by the halo of mystery and push-button fantasies around the new discovery, that the atomic diplomats of the United States sought to exploit.

One of the principal sources of confusion was the belief assiduously cultivated in this country that the adoption by the United Nations of the American control scheme, the Baruch Plan, would in itself assure peace. This was a delusion, for any workable control system must result from a peace settlement among the big powers, and atomic control is only one among other important elements of such a settlement. Furthermore, the real objective of the American plan is to extend the existing atomic monopoly on a world scale, within a system in which the United States would be dominant, and the myth of the absolute weapon was to serve as a club to bring other nations into line. When the Soviet Union proposed the immediate outlawing of the bomb, together with all other weapons of mass destruction, and the general limitation of armaments, as the immediate and indispensable ingredients of a control plan, the American policy makers cited this as evidence of the Soviet unwillingness to cooperate and used it as an added pretext for pursuing the "cold war."

A new and deep crisis in science was thus provoked by the misuse of atomics. This has been happening to science in general, but the crisis is symbolized most clearly by atomics, where the contrast between military and peaceful uses stands out so starkly. The crisis in science stems directly from the inescapable and mounting contrast between the destructive and positive utilization of its achievements. The deepening of this contradiction is the result of the general deterioration of present-day capitalism. Atomics has become enmeshed in the entire complex of inner conflicts and tensions which are characteristic of the demise of the entire system.

In the midst of this crisis of science it has been suggested seriously that we might atone at least in part for the act of Hiroshima and avert new Hiroshimas by indefinitely discontinuing the large-scale production of nuclear fuel.[1] One may as well propose that we deliberately destroy all industry and the accumulated skills of labor, since they are necessary to modern warfare. With equal logic one may suggest that we destroy half our productive capacity because another economic crisis may reduce our output by half. This counsel of despair has nothing in common with the realities of world politics and social development, nor with the true function of science, which is to enlarge our mastery of nature for the purpose of improving the mode of existence of mankind.

The real depth of the crisis in science is revealed once we recognize how it is rooted in the basic contradiction of our society between private appropriation and social utilization. Progress in the application of atomics to industry, for example, would lead to another leap forward of our productive forces, on top of the high level of technique already achieved, which capitalism is unable to use constructively to satisfy the real needs of mankind. Following the last war, the basic contradiction already mentioned assumes unparalleled proportions on a global scale, typified most clearly by the swollen productive capacities of the United States in the midst of a shrinking and impoverished world market.

For this central impasse there is only one fundamental solution, the socialist transformation of society, with its abolition of private appropriation of national resources and the fruits of labor, and its assurance that our productive forces will be used to the maximum for the benefit of the people. If science is again to stand on its own feet in our country, and make its rightful contribution to society, it must be liberated from monopoly capital, and provided a base, which socialism alone can give, in accordance with the stature and potentials of modern scientific development. Frederick Engels placed it thus in discussing the deterioration of bourgeois philosophy: "The more ruthlessly and disinterestedly science proceeds, the more it finds itself in harmony with the interests and efforts of the workers."[2]

Let us hope that we can avoid the abyss towards which we are thrust by decaying capitalism before we take the road to socialism. That will depend upon how successfully the American working class and its democratic allies, the vast majority of the people, meet the dangers that now confront us.

For we are faced with immediate and acute dangers. The "excess" capacity with which we are already plagued, even before the industrial application of atomics and other new techniques, expresses itself in the form of a crisis of overproduction, which may become extremely acute. The militarization of atomics and of other significant areas of our economy increases the danger of war. The closer coalescence of monopoly and the state raises the specter of fascism.

These real and pressing dangers to our people and the world can be met only in the mainstream of the people's struggle for peace, democracy, and economic security. Just as the development of our giant industries has forced scientists from their garrets and made them indispensable to the productive process, they have also been thrust into the maelstrom of political debate and action. They, too, face the choice between serving monopoly and militarism on the one hand or the people on the other, and many scientists throughout the world have recognized the fundamental identity of science with the people's struggle for a better life.

For these men the battle against fascism did not end with World War II. Nor need the crisis in science leave them disorientated and demoralized, for there is a firm and vibrant base in Marxism and in the achievements of socialist society which establishes the ground for the ideological independence of science from monopoly and its decadent theories and practices. In the identity with the growing people's movement against the new war incitement and the tyranny of "loyalty oaths" and affidavits that swear away the right to independent thought, the scientists have the opportunity to help save science in America from the same fate it suffered in Hitler Germany.

The demilitarization of atomics, as of science and education in general, is part of a genuine peace program. Science must be freed from its present military shackles, and permitted to explore the entire field of atomic energy, which has such enormous implications for all science and for society. The long-term lag of science in the United States can be overcome, if it is converted to peace, and the traditional principles of freedom of scientific interchange are re-established.

The doctrine of "free access" so devoutly followed by American expansionists with respect to the wealth of other nations should be applied first of all in the United States by granting free access to atomic raw materials, the main sources of which have been monopolized for military production. The discoveries and processes of the American atomic enterprise, to which foreign scientists made such great contributions, ought to be made generally available for peaceful purposes. The technology of atomic power should become the concern of the entire government-owned industry and its benefits shared with other countries, especially with the peoples in the economically backward areas who are endeavoring to gain freedom from imperialism and from centuries-old poverty. The nuclear fuel stored in the American stockpile should be used for power plants instead of bombs.

The dismantling of these bombs, which are symbolic of the belligerent and reactionary policies now dominant, can be assured if the people assert their will to peace. The people's will can also dismantle our entire present foreign policy, which leads towards war, and replace it with the policy for which we fought in the war, the policy of co-operation among all the peoples for peace.

In co-operation with the great global peace front, which has been greatly reinforced by the democratic and socialist advances resulting from the defeat of fascism in World War II, the American people can turn the tide at home, away from reaction and towards the path of progress. Along that road we can harness our great productive forces to the needs of the people.

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